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LAND USE AND ENERGY: A STUDY OF INTERRELATIONSHIPS

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HENRY M. JACKSON, *Chairman*

COMMITTEE ON INTERIOR AND
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MEMORANDUM OF THE CHAIRMAN

To Members of the Senate Interior and Insular Affairs Committee:

Two of the most critical challenges facing this Nation are how to insure the wise use of our land resources and how to maintain adequate and reliable sources of energy. This Committee has been deeply involved in both of these issue areas through its conduct of the Senate's National Fuels and Energy Policy Study and through its deliberations on surface mining and coal leasing legislation, public land and Outer Continental Shelf leasing measures, siting bills, and many other legislative proposals on land and energy matters.

Yet, to date there has been very little success in addressing land and energy issues in concert in policy making and administrative contexts even though the interrelationships of those issues are obvious.

Our Committee has reviewed numerous plans for energy independence each of which envisions several thousand new energy facilities. The construction of a significant number of those facilities would involve some of the largest public works projects in the history of the Nation. Certainly the siting, construction, an operation of those facilities will have a profound effect upon this Nation's land resources. I have been deeply concerned that the need for those facilities and the Nation's energy problems in general may appear so critical as to compel the Congress to endorse a "single-purpose" short-term energy planning approach without sufficient recognition of the dangers such an approach might hold for the long-term future of our land.

Indeed, as we have heard repeatedly in our committee sessions, many States and local governments have already expressed dismay that single-purpose energy planning, if permitted to override broader planning goals, could create a land use nightmare: Farmers could be deprived of water for irrigation, if not of agricultural land itself; trailer park energy boom towns would spring up with inadequate schools, roads, hospitals, and other essential services; delicate ecological systems and food chains could be disrupted; urban sprawl would continue unabated in areas where energy development occurs. In short, an "efficient" approach to energy facility siting by the Federal Government might undo recent initiatives of the States to better plan and manage the use of land for the long-term welfare of their citizens.

The objections heard to various proposals to force States and localities to comply with national energy development needs or plans are not those of a few disgruntled environmentalists. Increasingly, State and local governments have themselves been assuming the role of intervenor in energy development disputes through legislation and court action. It is becoming increasingly difficult simply to dismiss such objections as an obstinate reluctance to acquiesce in energy policies deemed to be in the national interest. Such a definition of the national interest is hardly persuasive to those governments who must

play host to large-scale energy development which can destroy vast landscapes so thoroughly that the National Academy of Sciences has dubbed them "national sacrifice areas."

Recognizing the critical need to better relate land use and energy issues and avoid the inherent dangers of adopting too narrow a focus on energy development or any other single use of land, I introduced, in 1970, a national land use policy bill to assist State and local governments to develop land use programs for the various, critical land uses, including the siting of energy facilities. Succedent versions of this bill were passed by the Senate in the 92d and 93d Congresses. This Congress I introduced, and several of my colleagues on this committee cosponsored, S. 984, the Land Resource Planning Assistance Act. The measure differs from the earlier land use legislation reported out of this committee in prior Congresses in that it contains a new title specifically pertaining to energy facility planning. Unlike S. 619, the administration's siting bill, S. 984 would insure the integration of facility planning with other land use planning objectives, would accomplish this at the State level, and would not involve Federal override of State planning prerogatives.

It is possible that this legislation can, in the light of recent events, be improved. It is my opinion, however, that unless the Congress acts to develop an integrative approach such as that envisioned by S. 984, it will be impossible to reconcile the destructive conflicts between land-use and energy goals.

This reconciliation is no easy assignment. The interrelationships between land use and energy are as complex as they are numerous. To aid the committee in its deliberations on land and energy policy, I have asked that the Environment and Natural Resources Policy Division of the Congressional Research Service, Library of Congress, prepare a comprehensive report on the policy interrelationships of these two issues. Accordingly, a task force headed by Charles E. Little, specialist in environment and natural resources policy, was appointed to conduct this study. Contributing authors in addition to Mr. Little are W. Wendell Fletcher, Susan R. Abbasi, Connie A. Musgrove, and Howard A. Brown.

Their report, is, to my knowledge, the first full-scale treatment of land and energy policy issues. It is specifically intended to address the interrelationships of these issues well beyond the narrow focus of energy facility siting. Clearly, energy independence must not be bought at the expense of our land, nor need it be if, as this report makes plain, energy and land use goals can be appropriately integrated in national, State, and local policy.

HENRY M. JACKSON, *Chairman.*

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Committee on Interior and Insular Affairs

United States Senate

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CHAPTER I.—THE CONGRUENCE OF LAND USE AND ENERGY*

Introduction

Literature comprehensively relating land use and energy is virtually nonexistent; and where analysts do grapple with the interrelationship beyond the "siting" issue, they do so only tenatively. There are few data available, and even if there were more they would be of little use, for there is no policy framework within which to judge their importance.

The purpose of this report is to help to establish a framework, not for planning-for-siting, but for planning for land-and-energy development and conservation. In this way, the process of identifying the hand-holds for comprehensive policy analysis can begin—hand-holds that have proved, on the evidence, elusive for the Congress in both land use policy and energy policy when taken separately.

Elizabeth Drew, in a recent roundup article on energy in the *New Yorker*,[1] describes the difficulties in creating new policy constructs for energy—and by extension for land use—as arising from the emergence of a new category of political issues—the "issues of resource constraints," as she puts it. In a keen analysis of governmental intervention in private sector economics beginning with the New Deal, Drew describes how intervention has gone through two stages and is now on the doorstep of a third. The first stage involved restoring the post-crash economy to the status quo ante means of such "relatively simple" mechanisms as Social Security and other forms of insurance. The second stage, taking place 30 years later in the 1960's, had to do with direct intervention for the purpose of solving persistent social and environmental problems—through the war on poverty, housing programs, and other means.

The third stage Ms. Drew describes this way:

> With several of the questions about the second stage still unsettled, the country is confronting a third generation of issues involving Government intervention. These issues have several common characteristics: they are technical and highly complicated; they are not subject to resolution by spending; they cut across the interests of a wide variety of interest groups; and they concern economic resources that are seen to be shrinking rather than expanding. They cannot be settled by the traditional method of buying off—doing a little something for—the various competing interests. There is not much room for maneuver, not much that can be traded off. The solutions involve not giving things to people but asking them to give things up—something the Government has usually achieved only in time of war.[2]

*This chapter was prepared by Charles E. Little, Specialist in Environment and Natural Resources Policy, Congressional Research Service.

[1] Elizabeth Drew. "A Reporter at Large: The Energy Bazaar." The New Yorker, July 21, 1975.

[2] Drew, op. cit., p. 35.

As if these difficulties were not enough, Drew adds that issues of resource constraints "seem to connect with everything that is around to be connected with." Certainly land use and energy interact in fundamental ways to environmental, economic, and social concerns of all kinds. But to follow each interconnection to its multiple destinations is to create confusion, if not obfuscation. In a legislative setting there must be some optimum level of interpolicy connection that is neither so ad hoc or simple-minded that important consequences will be overlooked, nor so cosmically complex as to lead to inaction. The difficulties in dealing with land-use policy and energy policy as separate issues may have led to too little policy interconnection in the past. A fate no better would be to go too far the other way in the future. The objective of this report, therefore, is to attempt to combine the issues—land use and energy—in a way that avoids such impenetrable snares of interconnectedness that no legislative product is possible, or, to put it more affirmatively, to reveal interconnections that can show the way to a new order of policymaking.

Energy Independence Versus the Land Ethic

As ecologist-philosopher Garret Hardin's quotable phrase has it, "You can never do just one thing."[3] That is the lesson reflected in the growing conflict between energy and land use. When the city planners agreed that the Twin Trade Towers in New York City was a feasible idea, the project may have seemed at the time of its heavy promotion by former Mayor John V. Lindsay to be a land-use decision. But now it seems to have been an energy decision. How so? These two buildings in lower Manhattan use more electricity than the entire city of Schenectady. If the gargantuan Twin Trade Towers were wired up directly to Big Allis, Consolidated Edison's giant turbine generator, Allis might not be able to light another bulb in the entire lower New York State region it serves. It is only a single step from a Big Allis brownout to the justification of plans for expanding Con Ed's nuclear capability at Indian Point up the Hudson, or to build a cement lake in the Hudson Highlands at Storm King Mountain—a few miles further upstream—to provide a pumped storage facility to cope with peak loads.[4]

This is the way land decisions become energy decisions which then turn around to be land decisions again. In the Western States, along coastlines, and anywhere a utility covets a site for a nuclear plant, what seems logical for energy purposes is not perceived that way by those whose land is affected. Said an official group of Western Governors recently, "The Nation is looking to the West to assist in solving our energy problems. We desire to respond. However, we will not allow our air to be fouled, our water to be contaminated, our land destroyed, our people harmed."[5]

Fighting words like these have been emanating from all manner of official and unofficial quarters with increasing frequency. As of

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[3] Garret Hardin, "What the Hedgehog Knows" in Exploring New Ethics for Survival: The Voyage of the Spaceship Beagle. New York: Viking Press, 1972.

[4] See Robert H. Boyle, "Power, Power Everywhere." Chapter 8 in the Hudson River: A Natural and Unnatural History. New York: W. W. Norton, 1969. Boyle calls the Storm King battle, "The most fierce and publicized in the history of American conservation." The battle was started in 1963 and isn't over yet.

[5] Statement of the Western Governors' Energy Policy Office in connection with President Ford's successful veto of the strip mining bill. Quoted by Neal R. Pierce, "Western Governors: America's New Rebels." Christian Science Monitor. Aug. 6, 1975, p. 27.

November 1975, there were, astonishingly, some 3,000 lawsuits logged in at the Interior Department objecting to administration goals to develop Federal oil and coal resources. One of the suits, brought by the Sierra Club, held up no less than 183 applications for strip mining permits over 478,000 acres of coal-rich western landscape.[6] Interior Secretary Thomas S. Kleppe has had some fighting words of his own about State-level insurgence in the West: "We will seek wherever we can concurrence with the governments involved but we will not abrogate responsibilities that belong to us."[7]

The responsibilities Kleppe refers to are those proposed by the Ford administration to bring about energy independence. In his 1975 State of the Union address, President Ford asked for "200 major nuclear powerplants, 250 major new coal mines, 150 major coal-fired powerplants, 30 major new refineries, 20 major new synthetic fuel plants, the drilling of many thousands of new oil wells" in the next 10 years.[8]

The land use effects of such a program can be vast. Some 45 million acres would, according to the Federal Energy Administration,[9] be disturbed in one way or another—a calculation that does not include transmission lines or other transport facilities. This amounts to a tripling of the amount of land devoted to energy thus far in the course of American history. To devote 45 million acres to new energy development in 10 years would be like subtracting the entire State of Missouri from the land-resource base of the United States.

And this is the least of it. In the vacation States of the western mountains and deserts, in the coastal States, and in the Appalachian States—together totaling 40 States out of 50—the energy boom would create new settlements where none existed before, new cities where only towns had stood, sprawling new megalopoli connecting cities into endless urban regions as industrial and commercial growth gravitate to energy sources of supply.

All of this raises a policy conundrum for the United States that some think may well lie beyond the reach of compromise. The State of California, for example, has filed suit, with the express approval of Governor Edmund G. Brown, to halt offshore leasing plans of the Federal Government on grounds of economic, environmental, and social disruption.[10] In a companion suit, several municipalities and counties sought, for many of the same reasons, to block Interior Department leases over 1.25 million acres of Outer Continental Shelf in southern California. Though a Federal judge denied their request for a preliminary injunction, the plaintiffs said they would appeal the ruling.[11] Maine, Delaware, Massachusetts, and New York[12] are some other coastal States that have passed laws or brought suits that tend to modify-by-obstruction any thoughts by the administration that potential fuel shortages are a sufficient reason to change the delicate and complex balances of power between States and localities and the Federal Gov-

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[6] Bill Richards, "Kleppe to Press Coal, Oil Programs" Washington Post, Nov. 26, 1975.
[7] *Ibid.*
[8] Gerald R. Ford, State of the Union Message, Jan. 15, 1975, p. 11.
[9] Federal Energy Administration, Draft Environmental Impact Statement: Energy Independence Act of 1975 and Related Tax Proposals, Washington, D.C.: March 1975, p. 2–77.
[10] Gladwin Hill, "Oil Rights Value Stir Legal Fight." New York Times, Nov. 23, 1975, p. 36.
[11] Associated Press, "Court Refuses to Bar Oils Leases." Washington Post, Dec. 6, 1975, p. A2.
[12] The National Conference of State Legislatures and the Federal Energy Administration have compiled six months worth (Jan–July 1975) of state energy statutes (and likely proposals) into a 1107-page, two-volume compendium, Energy: The State's Response, Washington, D.C. NCSL/FEA, August 1975.

ernment. Coal States in Appalachia and throughout the northern plains have also resisted, not only en bloc, such as through the Governors' energy office, but also individually. In South Dakota, for example, the State's attorney general, commenting on a proposed coal slurry pipeline that would draw off precious water from agricultural use in his State, allowed that "They'd have to have a Federal marshall along every mile" of the pipeline's length to enforce its construction.[13]

As cries of colonialism mount [14] from official and civic resisters of coal and oil exploration and development, the nuclear scene has not been any calmer. Where once "the peaceful atom" was hailed by many conservationists and consumerists as a viable answer to power needs, lately there has been a nearly total about-face. In Vermont, for example, legislators responded to civic displeasure over nuclear plants by recently enacting a law that requires both houses of the State legislature to approve any project before the Public Service Commission is allowed to issue a permit for construction.[15] So constrained is nuclear development, by capital and materials requirements as well as by environmentalists' assaults, that Ralph Nader has flatly predicted that nuclear plant construction will be halted within 5 years.[16] Two new books, *We Almost Lost Detroit* and *The Prometheus Crisis*, along with Nader and a million or more [17] antinuclear activists urge that fission power be sent to the same limbo that Rachel Carson and her followers sent DDT 10 years ago. In California, in fact, an antinuclear proposition will be put on the ballot next year under that State's constitutional right of citizens to take legislative initiatives of their own. A California coastal planning statute came from the same source a few years ago (Proposition 20), which radically increased the right of the public to intervene in private decisions affecting treasured resources such as California's coastline. Based on the success of Proposition 20, the odds are that the antinuclear proposition may have a reasonably good chance to pass. Activists are planning similar legislative initiatives in at least 13 other States.[18]

The nuclear controversy, together with State-level and local and civic recalcitrance in the matter of fossil fuel development, seems to reflect something far deeper than mere grumbling about safety standards or environmental or economic effects which can be palliated by an adjustment here or a compromise there in energy development plans. The resistance may derive from a more profound impulse relating to what Aldo Leopold called "the land ethic." When he first voiced the concept in the 1940's, Leopold had no confidence that it would have an effect on policy soon, if ever. But the emergence of a land ethic was the primary finding of the Rockefeller Task Force on Land Use and Urban Growth in 1973. They called it "the new mood." [19]

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[13] Bill Richards, "Water Is Key to Coal Pipeline Fight." Washington Post, Dec. 1, 1975.

[14] The Governor of Colorado, Richard Lamm, put it his way at the Democratic Governors Conference a year ago: "Our position is easily misinterpreted. We belong to the United States and we're proud of it. We're not blue-eyed Arabs trying to hold up this country. But we are saying that there are certain things that happen to colonies—whether they are Colorado or the Congo—if there is not some assertiveness on the part of their leaders. And we are not going to be colonized." See David S. Broder. "A Regional Alliance in the West." Washington Post. Nov. 23, 1974.

[15] Center for the Study of Responsive Law. Citizen's Guide to Nuclear Power. Washington, D.C., November 1975. p. ii.

[16] "The Great Nuclear Debate," Time, Dec. 8, 1975. p. 36.

[17] Center for the Study of Responsive Law. Op. cit. p. ii.

[18] Ibid.

[19] "A new mood in America has emerged that . . . appears to be part of a rising emphasis on human values, on the preservation of natural and cultural characteristics that make for a humanly satisfying living environment." The Use of Land. New York: T. Y. Crowell, 1973. p. 155 ff.

Leopold's "land ethic" concerns the "land community" which includes waters, plants, animals, man and the settlement of man, as well as the basic land-resource itself. "That land is a community," wrote Leopold, "is the basic concept of ecology, but that land is to be loved and respected is an extension of ethics." [20]

As presently expressed, the land ethic seems to have three elements:

First, new understandings of the need to maintain essential natural processes in equilibrium. This is the result of a remarkably sophisticated comprehension of what was once the arcana of a little known science, ecology. Public perceptions of ecological balance are now fairly well developed, particularly as they relate to the hydrological cycle, to natural hazards, and generally to the economic functions of various ecosystems.

Second, the need to control growth. "Timed development" ordinances in such places as Ramapo, N.Y., and Petaluma, Calif., are the logical and expected community reactions to suburban and exurban growth that has taken place with such speed in postwar years that environmental, social, and economic patterns have been violently disrupted. The growth control impulse is not confined to metropolitan areas but also obtains in many recreation-resource areas—seashores, mountains and deserts where substantial housing and commercial development has been taking place. Moreover, it is widely understood that certain kinds of "key facilities" are major contributors to unbridled growth. These facilities include transportation links such as roads, bridges, mass transit facilities, shopping malls, large residential development, industrial parks—and by extension energy parks—and other such development.

Third, the need to preserve "livability." This word describes land values that have emerged in a large segment of the population since World War II. Whereas once the American dream was thought to be achievable if only one had enough money to buy a piece of Eden and a vehicle for transportation in and out of it, today it has dawned on many disenchanted suburbanites and others that Eden cannot be subdivided, and that pollution pollutes people on 1-acre lots the same way as those in public housing projects. Hence, a new appreciation of landscape and environmental quality, together with economic and social stability informs public attitudes about land and land use. These attitudes have been responsible for efforts in park and open space acquisition and preservation, for improved design aesthetics in roadside, housing, and commercial development planning, and the reluctance of many communities to welcome large industrial or commercial facilities into their midst even though such facilities could relieve property taxes significantly.

Although the land ethic—ecology, growth control, and livability—is evidently not a fad, it does not necessarily follow that there isn't deep ambivalence about the land-energy issue—an ambivalence dramatized by this exchange among citizens of Minneapolis. The meeting at which these comments were recorded was held in a springtime that followed a gelid, deep-snow winter plagued by shortfalls of heating fuel:

"I think it's immoral to go out there and do to Montana what they did in northern Minnesota to get the iron ore out," said a woman who wrote a column for a suburban newspaper. She was speaking of coal.

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[20] Aldo Leopold. A Sand County Almanac. New York: Oxford University Press, 1949.

"That's hardly a scratch on the surface compared to what strip mining's done to the South," observed an architect.

"I've been to Kentucky; I've been to Appalachia," said a schoolteacher, shaking his head. Then someone asked, "OK, well, that's the position you take. All right, we're not going to take the coal out of Montana then, so the industrial plant of this city is not going to keep growing any more; then what's going to happen to this metropolitan area if you don't take the coal out of Montana?"

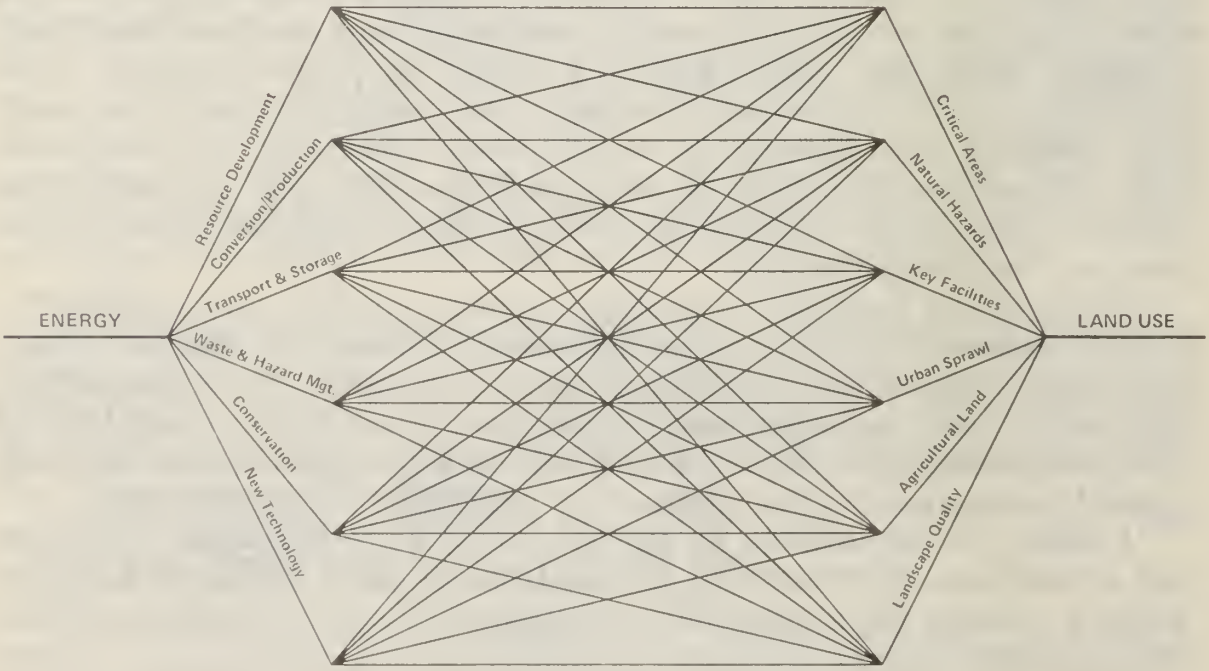
Nobody knew.[21]

What they, and every one else, seem fully to understand, however, is that for better or worse, energy development is going to be a primary determinant of land use—in Montana, in California, in Ramapo, and in Minneapolis. And they recognize too that land develpment is going to be a primary determinant of energy use—be it the Twin Towers of Manhattan, or an all-electric subdivision named Sugarland Run in Virginia where the utility bills to the homeowners are often larger than the mortgage payments.

The Cat's Cradle of Land Use and Energy

In order to perceive what kind of legislative possibilities might arise from a joining of land use and energy considerations into a single new policy concept, it is first necessary to take a hard look at the interrelationships in something of a structured way. By arraying the basic components of energy against the basic component of land use, one might be able to discover modes of interconnection that could lead to legislative ideas that are neither so simple—as in planning-for-siting—not so cosmically complex—as in "everything is connected to everything else"—that virtually any action is impossible. To achieve a structure for analysis, a "cat's cradle," is shown on the following diagram which indicates some 36 major interconnections between energy and

ENERGY AND LAND USE:
INTERRELATIONSHIP OF PRINCIPAL COMPONENTS



[21] From Charles E. Little, "Preservation Policy and Personal Perception: A 200 Million-Acre Misunderstanding" in Erwin H. Zube, et al. Landscape Assessment: Values, Perceptions, Resources, Stroudsburg, Pa.: Dowden, Hutchinson and Ross, 1975, p. 54.

land use. The most salient of these interrelationships will, for the purpose of this paper, be examined from the standpoint of land use, although an analysis from the standpoint of energy should theoretically yield approximately the same information.

CRITICAL AREAS

An extreme interpretation of what constitutes an ecologically critical area can encompass virtually every acre of land. But it is not extreme to allow that many new energy development schemes do in fact create serious problems in maintaining the ecological integrity of critical land areas. For example, offshore oil development can have a serious impact on the fragile littoral. The coastal zone is the site of diverse ecological functions, including but not limited to marshes as a food source for coastal fisheries. Onshore oil facilities, including platform fabrication sites, energy conversion facilities, and storage and distribution facilities can displace the ecological functions of vital marsh areas. Moreover, possible seepage, wastes, and spills from oil exploration and development can further damage the marsh ecosystem and contaminate beaches and bird life as well—all of which interlock in a food chain that is vital not merely as a textbook illustration of ecology but as an important element in human food supply and its associated economic system.

Other examples of critical area problems created by energy development include the well-known issues arising from the Alaska North Slope pipeline and, more recently, the issues arising from increased strip mining in the interior Western States. There is no assurance—and much expert opinion to the contrary—that even huge outlays of money spent on grassland restoration after stripping will bring about full recovery of the original ecosystem within any reasonable time. This suggests an important economic impact, as well as a cultural one, on the areas' traditional use of land for agriculture and range.

Further examples of the effects of energy development on critical areas concern nuclear power plants, and the waste products of these plants—especially thermal pollution. Because such plants ordinarily require water for cooling, they are more likely than not to be sited in a critical environmental area. Electrical transmission lines, especially as they proliferate, cannot help but intersect critical areas in their path. Additionally, other transport methods, especially coal slurry pipelines, and major oil and gas pipelines, even though buried, may have an undesirable impact upon critical areas. New technology, too, may not always be able to avoid interrupting natural processes. Giant solar collectors have been described that would cover scores of square miles of desert; yet no one has analyzed the effects they might have on that fragile ecosystem.

NATURAL HAZARDS

In general, energy development may exacerbate natural hazards in certain areas. As is known, much inappropriate development is already located on flood plains. Should the hydrological regimen be altered by energy development—through increased runoff, siltation, and the like—these flood plains would be increased in size, with increased intensity and frequency of flooding. A case in point, though perhaps

overly dramatic, is the Buffalo Creek disaster, in which an earthen dam created by coal mining operations in West Virginia gave way and wiped out an entire settlement.

In the coastal zone, too, energy development could increase the incidence of natural hazard. Marshlands, if drained, can no longer function as zones for the absorption of wave shock during hurricanes, and changes in dune formation as a result of dredging for ports or other purposes could lead to primary and secondary dune breakdown—even at some distance from the dredging site—permitting storm-driven tides to inundate coastal settlements. In fact, it is even possible to conceive of increases in earthquake damage along fault lines should the geological equipoise be upset by certain kinds of mining operations, forced water intrusion into wells, subsidence associated with oil recovery, or other kinds of fault-line aggravation. Certain other technologies proposed, such as heat storage wells created by thermonuclear explosion, might create a major hazard where only minor seismic activity would be experienced otherwise.

KEY FACILITIES

The land use issue concerning the location and size of "key facilities" is perhaps the best understood part of the land use and energy interrelationship. In terms of land use policy, key facilities are important not only because they are major users of land, but more because they create secondary uses and effects that dwarf the impact of the facility itself. This would be especially true in connection with energy facility siting, for not only would a complex infrastructure have to be created—schools, roads, housing, and municipal services of all kinds—but also the location of certain kinds of energy facilities could have an effect on land use and settlement patterns throughout an entire marketing and distribution area.

Industry will tend to cluster around energy supply, and workers, commercial services, and all the rest will shortly follow. Major development of energy facilities could permanently alter the structure of land use for whole regions, perhaps even creating new conurbations where only scattered settlements had existed before. In short, key energy facilities might well produce key facilities of other types, which in turn would produce land use effects in ever widening circles of influence.

These effects would hold true for areas of primary resource development, such as the Southwest and northern Plains—for coal—Alaska and certain coastal areas—for oil and gas—as well as for areas given facilities of conversion, transport, transmission and storage are located.

Moreover, the land use changes required by waste and hazard management would have their own impact on land settlement and use patterns. Nuclear disposal sites, for example, may require large buffer-zones which could depress local economies and land values and preclude certain land uses that might ordinarily obtain.

URBAN SPRAWL

Energy development and its concommitant, energy conservation, can have interesting effects on this pervasive problem. Sprawl, as a phenomenon, arises from two different, though not unrelated, trends. The first is centripetal metropolitan centralization and the second, the centrifugal motion of city people to suburbs. The city as entrepot, a

role required by capital concentration in an industrial society, is by its very nature culturally unstable, politically monolithic, and, for many, socially repressive. Hence, as urban skills are learned, by—usually—rural immigrants, the denizens choose smaller social and political units—suburban towns—in which to live and sometimes work. These places tend to be more amenable and the political apparatus is not beyond the reach of the average resident.

Though centrifugal suburbanization is augmented by improved transportation modes, it was not caused by the interstate highway program. Suburbanization pre-dates the great investment in limited-access highways by at least 50 years. The effect of highways has been more pronounced on an associated phenomenon of metropolitan growth called "conurbation." This is the linking of pre-existing independent cities and towns into large megalopolitan units.

Energy development, if centralized in, say, large energy parks to serve such conurbations, may tend to maintain or increase their size. More dispersed energy production facilities might reduce the problem of conurbation. Energy conservation measures, too, could have a startling effect on megalopolitan growth patterns and the degree of metropolitan growth itself as opposed to growth in rural and small town areas.

In existing metropolitan areas, reduced use of gasoline will tend to concentrate new development and renovation around mass transportation nodes; it will tend to encourage employment diversity and a self-contained economy in satellite cities, a trend that is already taking place; it will tend to create new housing on an "in-fill" basis, developing those areas overleapt by builders in the rush to large tracts in the metropolitan countryside; and it will tend to rejuvenate central cities, too, along with prewar suburbs which are now falling into disrepair.

An irregularity or reduction in supply and increases in the cost of energy may lead to the application of new technologies for energy supply—particularly solar-related systems—more quickly in metropolitan areas than is generally presumed. For example, a group of tenants on New York's Lower East Side have recently retrofitted an apartment building with solar hot water heating under a HUD grant program.

Much experimental work in small-scale, community-level energy facilities is now going on in rural areas as well. Small-scale, self-sufficient energy systems can help to break the self-reinforcing pattern of urban sprawl by reducing dependence on large, metropolitan-based utilities. In fact, a recent—June 1975—Department of Agriculture study by Calvin L. Beale, of the Economic Research Service, "The Revival of Population Growth in Non-Metropolitan America," reveals that nonmetro growth between 1970 and 1973 outstripped metropolitan growth—4.2 percent for nonmetro versus 2.9 percent for metro areas. Of this increased nonmetro growth, not all was in counties adjacent—some 4.7 percent—to metropolitan areas, as most planners might conclude. In fact, as Beale puts it, the "significant point is that nonadjacent counties have also increased more rapidly than metro counties (3.7 percent vs. 2.9 percent). Thus, the decentralization trend is not confined to metropolitan sprawl."

A logical surmise from these data is that as decentralization increases, a greater "market" for small scale energy systems may increase with it. Then, as smaller communities become more viable economically, this type of settlement pattern may begin to displace the entrepot megalopolitan area in significant new ways.

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It is Beale's belief that this will be all to the good. "Under conditions of general affluence, low total population growth, easy transportation and comunication, modernization of rural life, and urban population massings so large that the advantages of urban life are diminished, a downward shift to smaller communities may seem both feasible and desirable."

The implications for land use and energy policy in this regard are vast, since in both cases, basic assumptions have heretofore centered on the need for large scale infrastructural systems to serve in increasingly conurbanized population. The new trend toward decentralization could, if sustained by events, render much of the conventional wisdom of energy and land use policy formulation inappropriate.

AGRICULTURAL LAND

The problem of the preservation of class I agricultural land is related to urban sprawl, in that some of this land such as in New Jersey and California—has been lost through urbanization. While the total amount of acreage is not great, the areas involved quite often contain agricultural land that is appropriate for specialized or perishable crops—as opposed to commodity crops—and is strategically located close to large markets.

Other agricultural land losses derive from interruptions in the hydrological regimen. Damming itself floods otherwise productive acres; withdrawing water for industrial and urban uses can lower water tables, significantly affecting production; and irrigated lands risk, after a period of years, gradual accumulation of salts which not only reduce productivity, but can completely destroy the primary productive capacity of such land for any kind of crop.

The effects of energy development may tend to exacerbate these problems and add new ones. For example, land disturbed by strip mining can lead to changes in the composition of ground and surface water supplies, affecting production. In Napa County, Calif., thought to be the best wine-grape region in the United States, vinyardists are concerned about the possible effects of a geothermal generating unit at the head of the valley which could create an adverse microclimate. Burying nuclear wastes could take large areas of crop and range land out of production, should there be an unexpected diffusion of radioactive materials. Increased use of coal for electrical generation could lead to significant crop destruction through "acid rain."

Energy conservation policies, too, might have a major effect on the shape of agricultural economics in the United States. Decreases in the use of petrochemicals for fertilizer as well as for herbicides, insecticides, fungicides and for vermin control might lower production levels.

Increased costs for transportation may, even though these are now a small part of the cost of agricultural goods, increase food prices, as would increased prices for the fuel needed to run large and highly specialized farm machinery.

Energy shortage, increased cost, and statutory conservation measures may have some interesting long-range effects as well. For example, should the cost to the consumer of certain garden crops—tomatoes, fruits, lettuce, and the like—continue to rise, it is likely that nonproprietary agriculture may increase more significantly than it has already, with more substitution of home-grown produce for store-bought produce. A 1972 Gallup poll shows that 4 out of 10 U.S. fam-

ilies grow some of their own food. Morever, the "decentralist" energy forms discussed above can relate to the development of a more labor-intensive agriculture which would be encouraged by a low energy future. Decentralized energy production would suggest more agricultural diversity, more part-time and subsistence farming, and shorter transportation links to major markets.

LANDSCAPE QUALITY

Though landscape quality—the aesthetic and cultural values of the land—is a difficult matter to determine objectively, the degradation of landscape is what has provided motive power for a large segment of the land conservation movement. This movement is quite aware of the impacts that energy development, conversion, transport, and waste products can have on the visual and recreational landscape. The various "fights" through the years need only to be mentioned here to dramatize the vigor with which landscape degradation is attacked: the battle over the Storm King pumped storage plant coordinated by the Scenic Hudson Conservation Conference; the Alaska Pipeline fight led by the Sierra Club and others; the denial of a permit to Aristotle Onassis to build an oil depot and refining facility in Durham, N.H.; the Delaware State law banning industrial facilities along the coastline; the Kaiparowits plateau controversy which has delayed coal mining and generating operations for 12 years in this scenic area of Utah—a controversy which has led to the withdrawal of the chief sponsors of the project. All of these issues show the conflict between landscape quality and energy development.

The conservation movement is generally in favor of a skip-step energy development policy—skipping over nuclear directly into solar, wind, geothermal and other new sources of energy—from the present fossil fuel base. Nevertheless, even the most environmentally benign technologies are not without their aesthetic drawbacks. Not only would coal stripping uglify the northern plains, but so would giant windmills. Energy from the sun may not require the withdrawal of energy capital, but at the macroscale of production—say, 1,000 megawatts—giant collectors may require a grid system taking up between 10 and 40 square miles of desert land.

Thus, in order to reduce aesthetic and cultural impacts on landscape quality, the new technologies would not only have to be really new, but would also have to be developed on a small-scale basis: individual or community wind, solar, thermal gradient, geothermal, methane, or other kinds of facilities.

Implications for Federal Policymaking

If the foregoing catalog of land and energy interactions is persuasive at all, it must lead to these theorems:

First, there is no way meaningfully to create a comprehensive land-use policy—to plan for land development and conservation—without being able to plan for energy development as an inherent part of this process. Energy development, like any basic element of the physical infrastructure, is both a primary user of land and a primary shaper of land use.

Second, there is no way meaningfully to create an energy policy—a plan for energy development and conservation—without being able to plan for the land needed for the purpose of extracting, processing, transporting, storing, and distributing energy and fuels, and to

modify land use decisions for the important permanent goal of inducing a settlement pattern that will help bring energy demand into balance with energy resource constraints.

These two theorems must, in turn, yield this kind of conclusion: What is needed is a truly constructive land-and-energy policy in which neither land nor energy is a subset of the other, but in which both are subsets of a larger policy format which, in the end, has to do with the nature of "growth" in the United States.

In an otherwise inchoate legislative setting for land use and energy, a land-and-energy policy could provide an organizing principle for both these controlling aspects of growth. Without such an organizing principle, questions of "who decides" tend to replace the essence of the matter, which is "what do we really want?"

If Federal intervention into land use policy is to have a constructive effect, most analysts believe it should be more comprehensive than the policy-by-default resulting from the necessity for State and local governments to weave in and around various Federal regulations and grant programs. By using energy development and conservation as the vector for intervention in behalf of the public interest, many if not all the policy goals for improved land use planning can be achieved, or better, reformulated so that the public interest is more perfectly expressed.

Similarly, energy policy in most important respects must do a kind of broken field running of its own, rather than being able to speed directly to its goals. The obstacles are presented by various expressions of the land ethic by means of constitutional appeals to State's rights, home-rule, and property-rights prerogatives as a way to protect environmental quality. By capitalizing on the land ethic—rather than fighting it—an energy policy might also achieve a better expression of long-range public interest.

Many analysts might well conclude at this point that the synthesis suggested by the two theorems is, however desirable, beyond the capability of a policymaking structure as diversified and pluralistic as that of the United States. Whether or not the merits of synthesis—a format for growth resulting in better land use and conservation together with better energy development and conservation—are pie-in-the-sky may well be beside the point.

The strong impression one gathers in reviewing the interactions of land and energy—through the cat's cradle or through the newspaper headlines—is that decisionmakers may have very little choice but to make a quite purposeful effort to produce policy integration. Two imperatives face each other across a policy chasm: the imperative implied by energy independence and the imperative implied by the land ethic. The chasm is there not only because these are "issues of resource constraints" but also because these are issues of intergovernmental relations with significant constitutional overtones. To put it flatly, the State of Colorado is not really willing to have its land use decisions made by the Federal Energy Administration—or by extension the President or the Congress. At the same time, the Federal Government is not really willing to let the State of Colorado dictate national energy policy.

To fail to solve this potentially volatile intergovernmental issue, which lies at the crux of any possible synthesis, is to reduce the future changes for a sound land-and-energy policy to odds that do not seem to bode very well for either energy independence or the land ethic.

CHAPTER II.—THE IMPACT OF ENERGY DEVELOPMENT ON LAND USE*

Introduction

More land is presently used for energy production purposes than for any other industrial land use except agriculture and forestry. Furthermore, the amount of land used for energy purposes could increase greatly in the coming decades if Federal plans developed to cope with the energy crisis are implemented to any substantial degree. These plans envision accelerated surface and deep mining for coal; construction of energy parks, some of which could be several thousand acres in size; development of new onshore support facilities to process federally anticipated increases in Outer Continental Shelf (OCS) oil and gas production; construction of a large number of new coal fired and nuclear powerplants and synthetic fuel plants; new hydroelectric dams; and greatly expanded construction of electric transmission lines and oil and gas pipelines.

An idea of the amount of land that could be directly affected by new energy development by 1985 is given in the Federal Energy Administration's (FEA) *Project Independence Report*, published in November 1974.[1] Using a model developed by the National Science Foundation, the Council on Environmental Quality, and the Environmental Protection Agency, FEA estimated existing energy related land use in the country on a regional basis, and also projected the amount of land that would be directly used in 1985 for energy purposes under "business as usual" and "accelerated" energy development assumptions.

The report indicated that 15.8 million acres of land were committed to "fixed" energy related land use in 1972. Fixed land use, as defined in the report, means land used in such a way that alternative uses are precluded for many years. An additional 2 million acres, in 1972, fell in an incremental land use category—that is, land excluded from alternative uses until reclamation is achieved, such as surface mined land.

By 1985, the report estimated between 35.6 and 35.8 million acres would fall in the fixed land use category. An additional 1.5 to 2.7 million acres of land would be temporarily excluded from other land uses (the model assumes that reclamation of surface mined land will be required in all States by law.) Hence, between 37.1 and 38.5 million acres of land could be used for energy production purposes by 1985—more than double the 1972 level. As a measure of scale, there are 30 States in the United States which have less than 38.5 million acres within thir boundaries. Figure 1, prepared by the Interior Department, displays the FEA land data.

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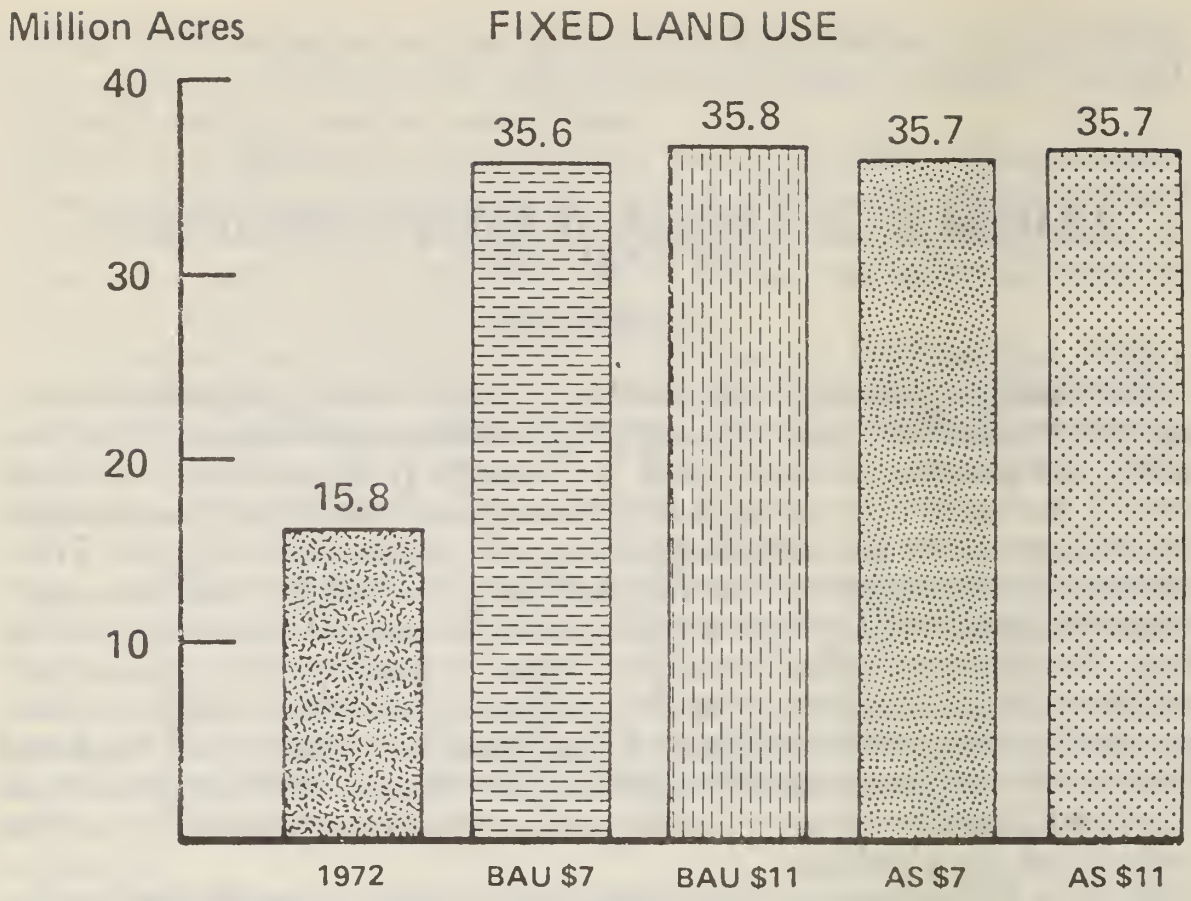
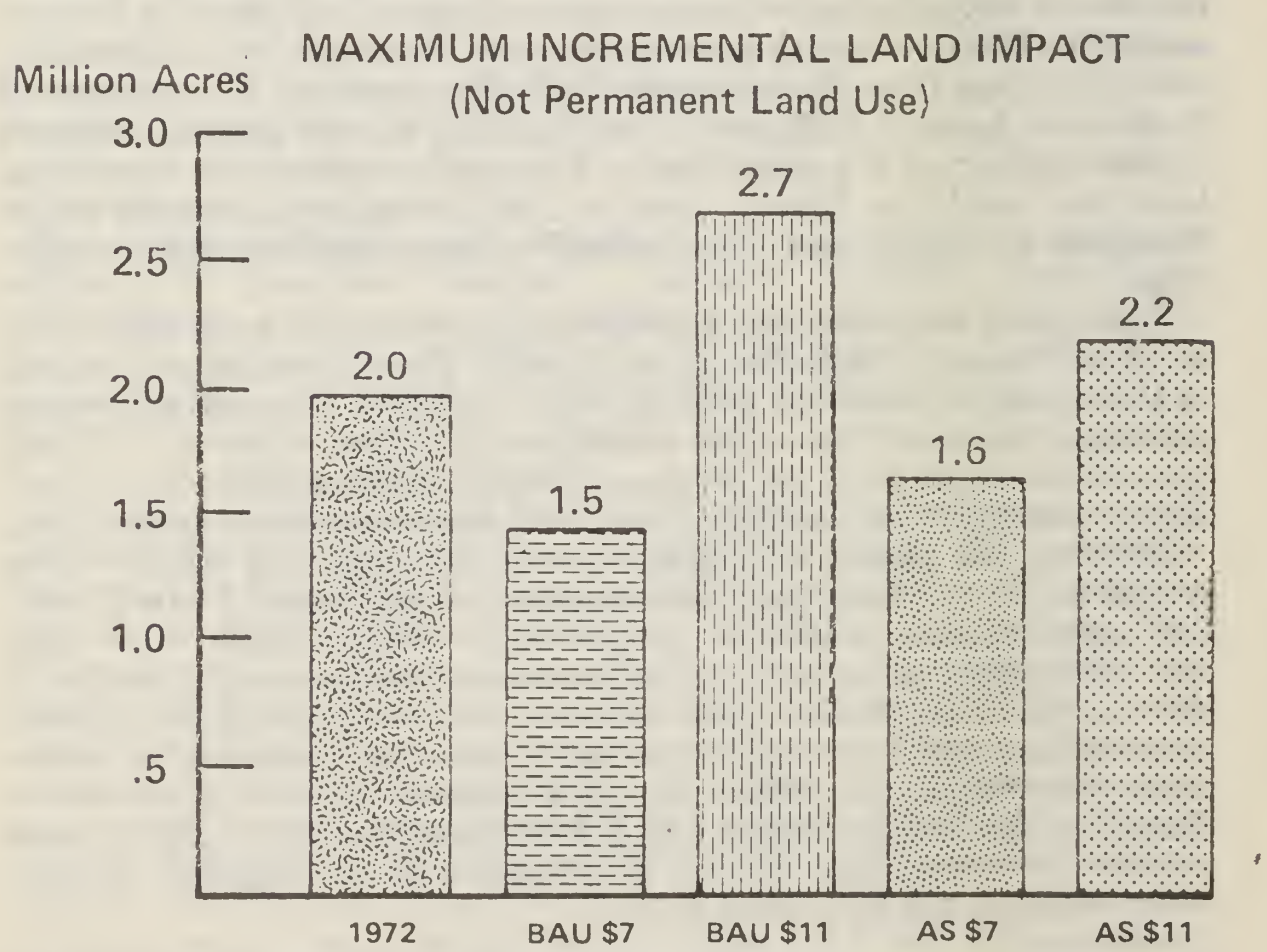
*This chapter was prepared by W. Wendell Fletcher, Analyst in Environment and Natural Resources Policy, Congressional Research Service.

[1] Federal Energy Administration, *Project Independence Report*. November 1974, pp. 213–214.





Source: Project Independence Report as adapted in *Energy Perspectives*, U.S.D.I., 1975.

FIGURE 1

FEA predicted even greater land disturbance should the President's proposed Energy Independence Act of 1975 be implemented. The agency's draft environmental impact statement on the proposed bill estimated that over 45 million acres would be affected: 25 million acres for coal mining; up to 20 million acres for hydroelectric facilities; 7,250 acres for oil shale development; and 823,000 acres for other energy related facilities, such as refineries, storage tanks and powerplants.[2] This is a land area about the size of the State of Missouri.

The FEA projections do not include land used for overhead transmission lines. The Federal Power Commission estimated in 1970 that transmission line right-of-ways covered 4 million acres of land—an area about the size of Connecticut—and that an additional 3 million acres of transmission line right-of-ways would be needed by 1990.[3] The FPC figures may be understated if a large number of mine-mouth powerplants, similar to the Four Corners plant in Utah, are constructed. These plants, which may be located a thousand or more miles from market areas, would require major new transmission lines.

Finally, the FEA projections are limited only to land used directly for energy material extraction and processing, and do not include estimates of the amount of land that would be devoted to secondary development stimulated by major new energy facilities. Many land use planners think that such secondary development will have greater land use and environmental impacts than energy development per se, particularly if the pace of energy development brings new population into remote areas at a rate beyond local capacities to plan for and reduce impacts.

Despite the enormous potential for adverse impacts on the land, few Federal energy development scenarios have dealt with land-energy relationships to an adequate degree.[4] The only land use issue that has been consistently recognized as an important constraint upon energy development is the problem of energy facility siting—the nuts and bolts problem of finding new sites for new energy facilities in a society with increasingly intense competition for land, and considerable local opposition to energy facilities. Broader issues pertaining to the amount of land committed to energy development, the impact of energy development on other land uses such as agriculture, forestry and recreation, and adverse impacts stemming from secondary development, have been given considerably less attention.

Yet to a degree paralleled only by the Federal Interstate Highway program, which transformed land use patterns across the Nation to a greater extent than any previous public works project and produced conditions conducive to the Nation's urban sprawl, Federal decisions will in large part determine how severe the impacts of energy development will be. Federal decisions about coal mining on public lands and leasing of federally held coal rights on non-Federal land; about leasing OCS land for oil and gas development; about Federal subsidies

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[2] Federal Energy Administration, Draft Environmental Impact Statement on the Energy Independence Act of 1975, and Related Tax Proposals DES–75–2, March 1975, pp. 2–77.

[3] U.S. Congress, Joint Committee, Economy, Energy, and the Environment, Prepared by the Legislative Reference Bureau of the Library of Congress, 91st Congress, 2d Session, 1970, p. 116.

[4] For example, the discussion of the land use projections just quoted in the Project Independence Report and the Draft Environmental Impact Statement on the President's Energy Independence Act of 1975 is limited to about five pages in texts totaling over 700 pages.

for high risk energy development; about research and development priorities; and about a host of other issues will influence greatly the timing, location, and intensity of new energy development and related secondary development. States and localities, however, will be left with the job of planning to avoid the impacts, since, under the Constitution, land-use regulation is thought to be an inherent power of State government.

Because of the sudden recognition that Federal energy development efforts could adversely affect State and local land use planning, legislation has been introduced in the 94th Congress to encourage States to conduct energy and land use planning in concert. Both Houses of Congress, for example, have passed legislation to amend the Coastal Zone Management Act, in order to address specifically the many problems associated with coastal zone energy development stemming from accelerated Federal leasing of Outer Continental Shelf lands.[5] The Coastal Zone Management Act of 1972 makes Federal grants available to coastal States for comprehensive land and water management of their coastal areas. A similar approach had been proposed in the Land Resources Policy and Planning Assistance Act of 1975, S. 984, which makes land planning grants available to States for establishing statewide land use programs. One section of the bill deals with energy facility planning.

These approaches differ from energy facility siting legislation proposed in each of the last three Congresses, and proposed by the Ford administration in the 94th Congress.[6] The siting legislation has been concerned almost exclusively with expediting State and Federal processing of applications to construct new energy facilities, and does not provide for significant integration of land and energy planning.

While land impacts from energy development will affect all regions of the country, the most intense impacts are expected in Alaska;[7] the sparsely populated, arid, interior Western States, which have large reserves of untapped coal and oil shale, the Appalachian region, and the crowded coastal areas of the country, which are adjacent to OCS oil and gas resources, which already receive most imported energy products and which are the most likely location for new nuclear powerplants.

Figure 2, from the *Project Independence Report*, shows FEA estimates of the gross acreage that could be required for new energy development in each region of the country if alternative Project Independence scenarios are implemented.

The Impact of Fossil Fuel Development on Appalachia and the West

Most scenarios for increasing domestic energy supplies foresee massive strip-mining of largely untapped Western coal reserves, in addition to intensified mining of all types in the Appalachian and Midwestern regions of the country. Ford administration officials, for example,

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[5] See S. 586 and H.R. 3510. As of April 1976, a conference on the two bills had not been held.

[6] The siting proposal, included in title X of President Ford's Energy Independence Act of 1975, was introduced separately in the Senate as S. 619.

[7] The problems associated with energy development and the Alaskan lands are not dealt with in depth in this report. Because of the unique geographic conditions in the State, and because of its climate, low population, and wilderness character, the energy-land relationship in Alaska is anomalous.

are anticipating coal production to double by the year 1985,[8] including a five fold increase of coal production from coal leases on Federal and Indian lands.[9] The administration also has anticipated the tapping of high-quality oil shale—80 percent of which is on Federal lands—and tar sand and geothermal resources in the coming years. Much of this new energy development would also be located in the interior Western States.

Many of the energy development scenarios also involve mine-mouth siting of major new coal burning powerplants, coal liquefaction or gasification facilities, and oil shale conversion facilities to synthesize petroleum-like products.

For example, in 1974, former Secretary of Interior Rogers C. B. Morton, called for "an all out national effort" to bring into being the Interior Department's "proposed solution" to America's energy problem: "vast mine, refinery and shipping points, already designated as COGS—for Coal-Oil-Gas." Morton went on to describe these massive mine-mouth facilities:

FIGURE 2

SELECTED REGIONAL LAND POLLUTION RESIDUALS

[Thousand acre-year]

	Fixed land			Maximum incremental land		
		1985			1985	
	1972	BAU, $11	AD, $11	1972	BAU, $11	AD, $11
Northeast	236	1,699	1,699	0	0	0
Mid-Atlantic	1,111	3,147	3,138	308.0	170.0	163.0
South Atlantic	519	2,708	2,661	775.0	750.0	488.0
East north-central	243	1,394	1,384	332.0	893.0	770.0
East south-central	1,020	3,554	3,544	499.0	499.0	422.0
West north-central	1,592	2,476	2,472	6.0	182.0	153.0
West south-central	1,547	936	949	12.0	91.0	65.0
Mountain	3,050	5,397	5,398	41.0	78.0	112.0
Pacific	6,448	14,385	14,387	3.0	10.0	10.0
Alaska	34	72	115	.6	.2	.3

Source: Project Independence Report.

> We envision the first of these as a $450 million prototype of a total energy-systems complex, located somewhere near a minehead and close to an industrial area. A site of perhaps 1,000 acres would be crammed with machinery, gasifiers, converters and refineries. Every day it would combine coal with water to produce large supplies of pipeline gas, synthetic oil, ashless, low-sulfur chemicals for plastic and petrochemical products, sulfur, cement, iron—plus cinder bricks and blocks.
>
> We should be building ten or more of these complexes by 1980, to increase our coal production by then from 500 million to 1,500 million tons a year.[10]

[8] See, for example, the statement of Dr. S. William Gouse, Deputy Assistant Administrator for Fossil Energy of the Energy Research and Development Administration in hearings before the Fossil Energy Subcommittee of the Committee on Science and Technology, U.S. House of Representatives, Feb. 18, 1975.

[9] Testimony of Assistant Secretary of Interior Jack Horton at hearings of Federal coal leasing held by the Subcommittee on Mines and Minerals of the U.S. House of Representatives Interior and Insular Affairs Committee, March 1975. This increase was calculated from existing active leases. Substantially greater increases were predicted for newly activated leases.

[10] Rogers C. B. Morton, "Coal: 'Our Ace in the Hole' to Meet the Energy Crisis," Reader Digest, March 1974, pp. 87–90.

President Ford, in his 1975 energy message to Congress, also envisioned a similarly ambitious energy development program. Among the goals advocated by the President which could particularly affect land use in the Western States and Appalachia: 250 major new coal mines, 150 major coal fired powerplants, and 20 major synthetic fuel plants, all to be in operation by 1985.

If such intensive energy development goes ahead, the Appalachian and Western States will bear a disproportionate share of the environmental costs. In addition to destruction of land by surface mining, and increased pollution from new energy facilities, there would invariably be a considerable amount of new economic growth and development in these areas. Without adequate measures to anticipate and ameliorate the impacts of the new development, many problems now associated with urban areas may be transfered almost overnight to largely rural and often primitive areas.

A key issue in development of Western coal fields is the choice of mining techniques: most scenarios, for economic reasons, expect surface mining, which now produces 52 percent of U.S. coal, to be the choice over deep mining—figure 3 shows the dramatic growth of coal production by surface mining in the last half century. Deep mining has significant adverse environmental impacts—acid mine drainage and land subsidence over mine cavities to name two—and the deep mine techniques used in the United States are far more dangerous to miners than surface mining.[11] Surface mining, however, has greater impacts from an environmental perspective, and will result in much land devastation unless adequate reclamation is carried out.

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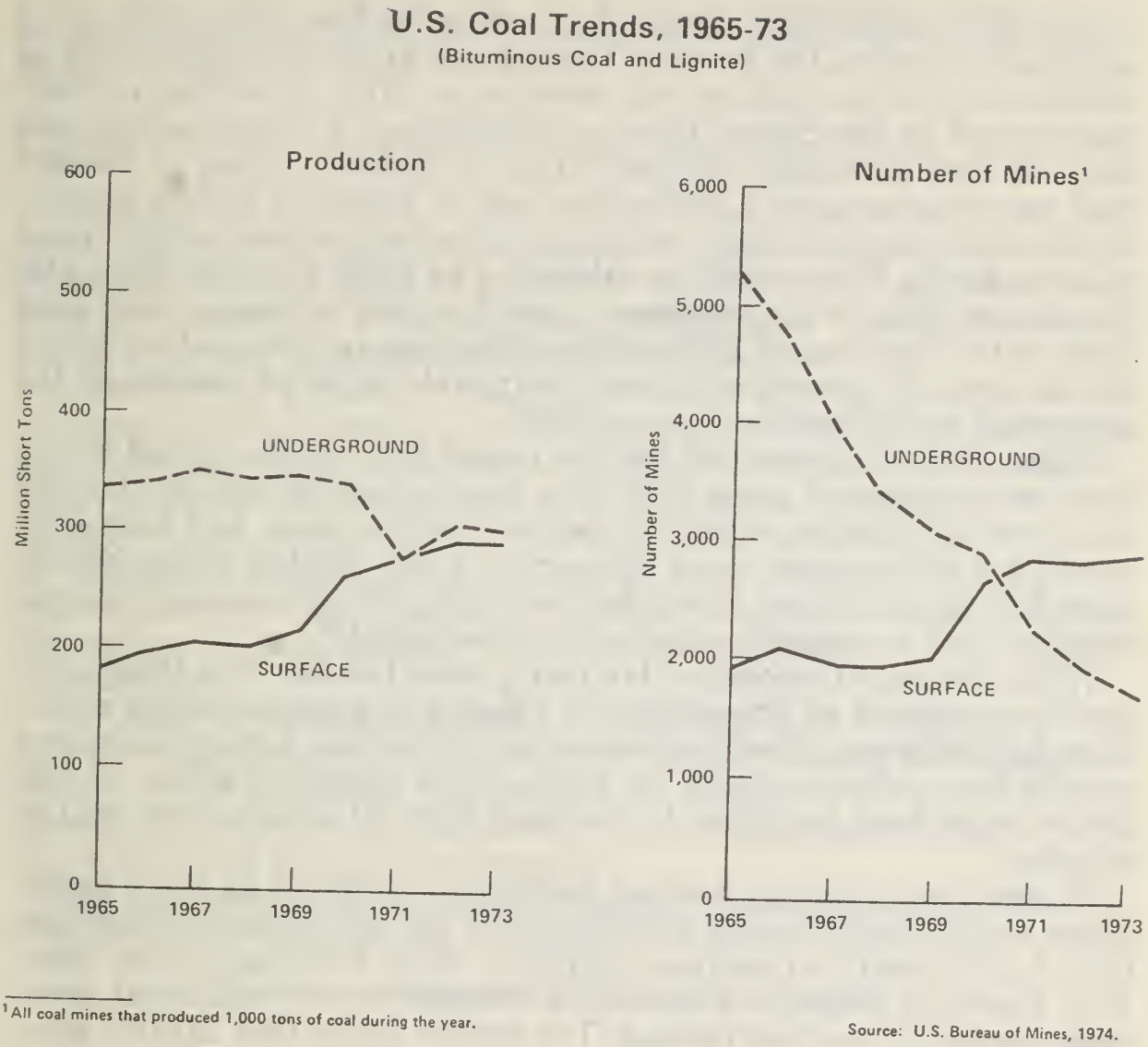
[11] Surface mining is less dangerous to workers in terms of fatalities per ton of coal produced per man hour. In terms of fatalities per man hour, however, surface mine and deep mine fatalities were about equal in 1974, according to one recent estimate. (See ERDA Authorization and Transition Period Fossil Fuels Hearings, February 1975, Committee on Science and Technology of the House of Representatives, p. 40.)



[1] All coal mines that produced 1,000 tons of coal during the year.

Source: U.S. Bureau of Mines, 1974.

FIGURE 3

A large amount of land in the United States contains coal resources. Of this, some 458,600 square miles is underlain with coal reserves thought to be recoverable.[12] By far the greatest amount of coal would have to be recovered through deep mining techniques, however. Of the 433 billion short tons of coal included in the coal reserve base, the Bureau of Mines classifies about 137 billion tons as potentially recoverable strippable reserves. About 110 billion tons are classified as recoverable through existing surface mining technologies, but only 55 billion tons are considered to be economically recoverable at this time. Thus, between only a seventh and an eighth of the coal reserve base is thought to be economically recoverable through surface mining under present methods.

As a measure of scale, however, the 55 billion tons is 200 times the 1974 total for surface mined coal and 10 times the cumulative production of surface mined coal in this country since the 1920's. The U.S. Geological Survey cautions against using these comparisons for estimating the life expectancy of strippable coal reserves, since, on the one hand, coal production is likely to increase greatly in the coming years, and, on the other hand, technology changes which could increase the size of the strippable reserves are also likely.[13]

[12] U.S G.S. Coal Resources of the United States, Jan. 1, 1974. Geological Survey Bulletin 1412. 1975, p. 33.
[13] *Ibid.*, p. 56.

Despite the difficulties involved in estimating the life expectancy of strippable reserves, the Interior Department apparently made such an estimate of surface mining coal reserves in 1974. According to testimony heard by the Senate Interior Committee,[14] a Departmental task force on coal extraction estimated that if surface mining of western coal grows to an annual production rate of about 1.4 billion tons by 1985, and continues at that level thereafter, all current surface mine reserves in the West would be exhausted by 1996. The task force also found, according to the testimony, that if eastern surface mining grew from 250 million tons in 1972 to 380 million tons in 1985, and continued at that level, 67 percent of current strippable reported reserves in the east would be depleted by the year 2000.

Three Federal surveys of surface mined land in the United States have been conducted since 1965. The most recent survey, by the Soil Conservation Service, estimated that 4.4 million acres had been strip mined for all purposes as of January 1, 1974. Of this, about 958,000 acres had been surfaced mined for coal. Only 337,000 acres of this coal stripped land was legally required to be reclaimed.[15]

While the actual amount of land strip mined to date is in itself quite small, the amount of land adversely affected by surface mining operations is significant. The Environmental Protection Agency estimated in 1973 that surface mining for all purposes presently affects 13 million acres of land, and that, by the year 2000, 20 million acres will be affected.[16]

To date, strip mining for coal has largely centered on the Appalachian region, and here the environmental impacts have been substantial. A 1972 study on surface mining in West Virginia by the Stanford Research Institute identified a number of environmental problems created by surface mining. The report found that 248,078 acres had been disturbed by the mining activities. If return to 75 percent of the natural vegetative cover was the definition of reclamation, more than 71 percent of the surface-mined land would be considered unreclaimed. Sediment yields were found to be 400 to 600 tons per acre per year in many areas. The study found a continuing danger of landslides even years after mining and reclamation work had been completed, and that an additional 400 miles of highwalls, benches, and outslopes would be created each year if mining continued as previously.[17]

Although less land is involved than in Appalachia, strip mining in the Midwest has led to significant conflicts with agriculture. Over 25,000 acres in Iowa, 43,000 acres in Kansas, 70,000 acres in Illinois and 74,000 acres in Missouri had been surface mined for coal as of

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[14] According to the testimony of the Environmental Policy Center, the figures cited appear in a March 1974, report prepared by the Interior Department's Coal Extraction Task Force entitled Coal Extraction R. & D. Program. The testimony was given during Senate Interior Committee hearings on greater coal utilization, June 10, 11, 1975. The Interior Department was unable to provide a copy of this report, but orally confirmed the general accuracy of the figures.

[15] U.S.D.A. Soil Conservation Service. Status of Land Disturbed by Surface Mining as of Jan. 1, 1974, by States. Mar. 26, 1974. The report notes that some States reported fewer acres disturbed by surface mining in 1974 than in a similar 1964 survey. The discrepancy was attributed to more accurate surveying methods in 1974, and SCS said that the overall national figure did not appear to be affected by these discrepancies.

[16] Testimony of the Environmental Protection Agency before the Senate Interior Committee on Surface Mining Legislation. Mar. 13, 1973.

[17] Stanford Research Institute, A Study of Surface Mining in West Virginia. Prepared for the West Virginia Legislature. February 1972.

1974. While these figures are small in themselves, continuation of widescale surface mining in these States could adversely affect future farm productivity.

Western Energy Development and Land and Water Resources

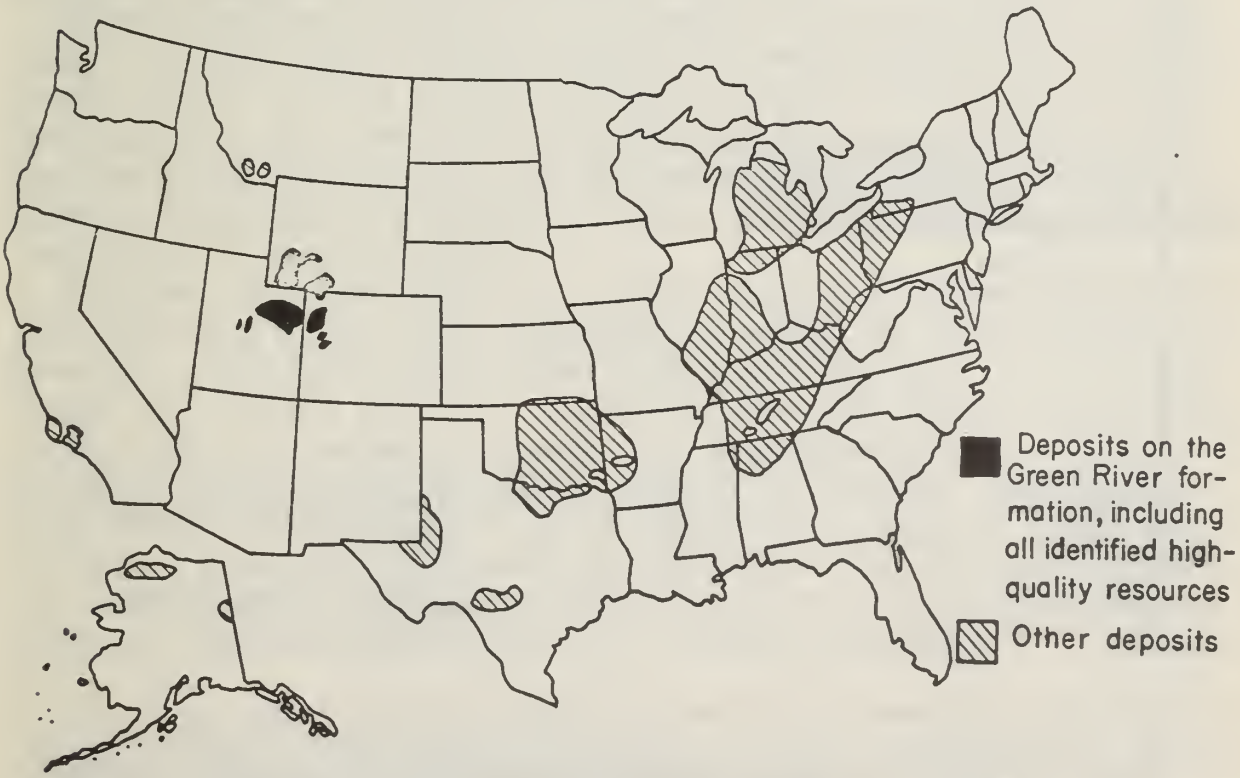
The growth of surface mining in the West is expected to be dramatic, although problems such as water constraints and political opposition to "the stripping of the West" continue to mount. There have been few studies on the amount of western land that would be disturbed by achieving given levels of production, however.

A study [18] by a panel of the National Academy of Science on the potential for reclamation of surface mined western lands estimated that 140 square miles of the West would be disturbed by 1990, and 300 square miles by the year 2000. The NAS study received a great deal of publicity in the western press because of its reference to "national sacrifice areas"—areas which because of their aridity and fragile ecological processes could be only minimally reclaimed once stripped. The report did not estimate the amount of land that would fall into this category.

Oil shale development programs could also have a substantial impact on western lands. Colorado, Utah and Wyoming have about 90 percent of the identified high quality oil shale reserves in the United States. (See fig. 4) Some 80 percent of this high grade resource is on land held by the Federal Government.

Like coal extraction, oil shale extraction could be accomplished by both surface mining or deep mining. For economic reasons, surface

Figure 4.—Distribution of U.S. oil shale resources.



Source: Duncan & Swanson, 1965.

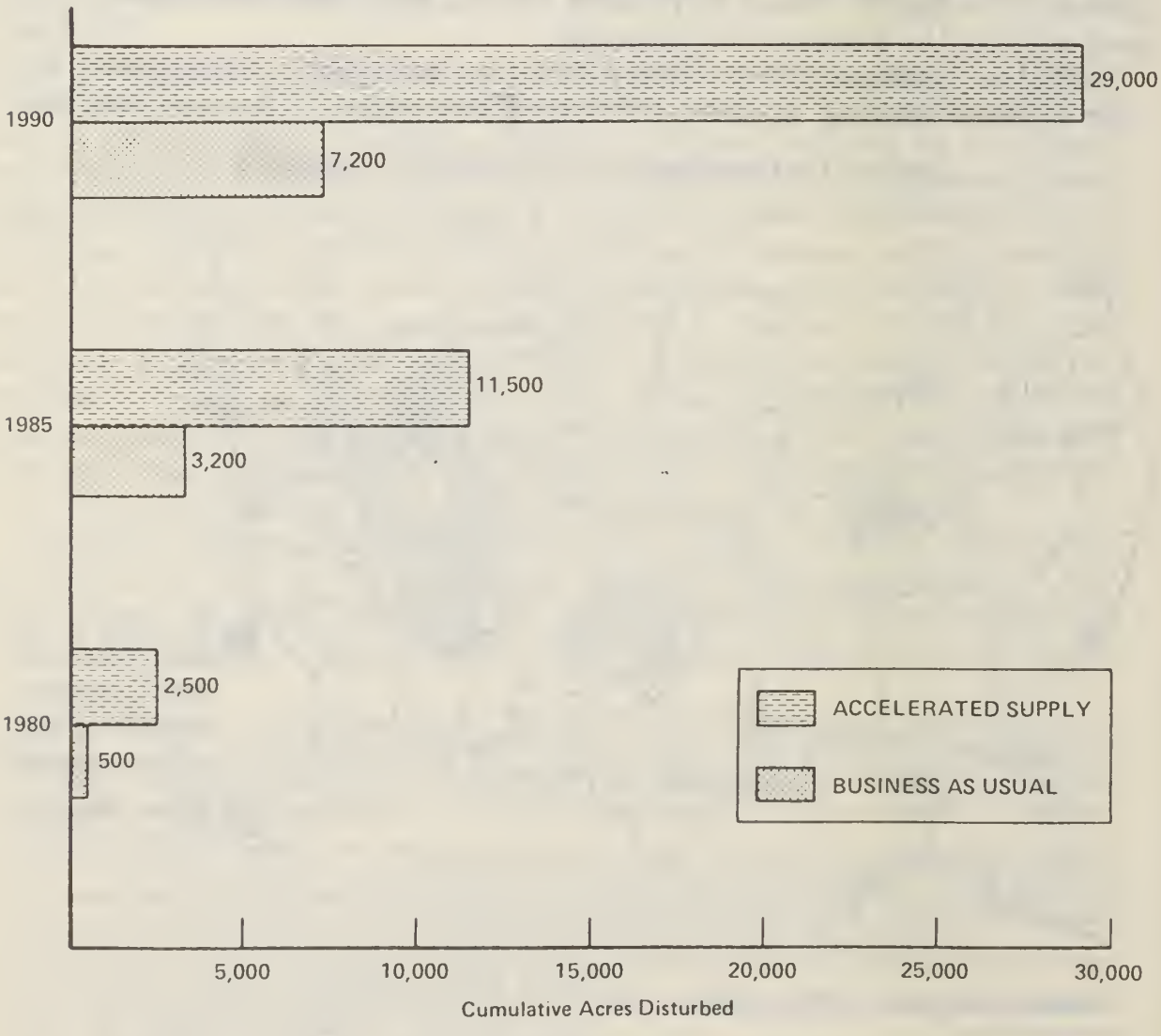
[18] National Academy of Sciences, Rehabilitation Potential of Western Coal Lands. A Report to the Energy Policy Project of the Ford Foundation (Ballinger Co.) 1974. 198 p.

mining for oil shale is likely to result in larger and deeper pits than for coal surface mining. To date, however, the oil shale mining operations in the United States have been deep mines.

A key issue in the development of oil shale will be whether *in situ* processing of shale oil, i.e. mining, processing and retorting in the ground, will be utilized instead of surface processing. Surface processing is thought to have greater environmental impacts, but *in situ* processing is still at the experimental stage. Key advantages of *in situ* processing include elimination of the need to dispose spent shale and reduction of air and water pollution problems.

Interior Department estimates of the amount of land that would be disturbed in achieving given levels of oil shale production over time are shown in Figure 5. The table indicates that 7,200 acres of land would need to be disturbed to achieve a level of production of 450,000 bbl of oil per day by 1990; by 2015, this same level of production would require a cumulative total of 21,000 acres. The projection apparently assumes that an additional 548 acres must be disturbed each year to maintain the 450,000 bbl per day production level. These land impacts do not include acreage devoted to utility corridors or secondary growth and development that could be expected around such facilities.

Land Impacts, Shale Oil Production, 1980-90



Source: Potential Future Role of Oil Shale: Prospects and Constraints, Project Independence Report, 1974, page 8.

FIGURE 5

In its impact statement on its proposed oil shale leasing program, the Interior Department did estimate the amount of land that would be affected by new utility corridors and secondary development stemming from an oil shale industry. The statement indicated that to achieve a one million barrel per day production level—a little more than twice the production assumption in Figure 5—about 15,000 to 20,000 acres would be needed for urban development induced by the oil shale operation, and up to 10,000 acres would be needed for utility corridors.[19]

Water is expected to be a significant limiting factor in the size and scope of western energy development. Whether there is sufficient water available for intensive energy development, as well as for other essential land uses has been the subject of a number of recent studies.[20] The NAS study on coal surface mining concluded that there would be sufficient water available for mining and rehabilitation of most sites, but that "not enough water exists for large scale conversion of coal to other energy forms—e.g. gasification or steam electric power.[21] If this is so, the likelihood of mine-mouth energy constellations in Western States may be reduced.

While most studies conclude that sufficient water is physically available for widespread western energy development, there is considerable concern about the impact of such utilization upon other land uses, and about impact on water quality. Felix L. Spark, director of the Colorado River Conservation Board has indicated that the Colorado River could supply 250,000 to 400,000 acre feet of water for an oil shale industry. However, Spark indicated that there would be a corresponding loss in agricultural production, and that there was no assurance that large scale oil shale processing could be carried out without significant contamination of the Colorado River.[22]

There have been a number of proposals in the last decade to undertake interbasin water transfer projects in order to assure an adequate water supply for the Interior Western States.[23] While active implementation of these proposals is prohibited by law until 1977, the energy crisis has stimulated new interest in the proposals. Should such a project go ahead, profound changes in the regional development pattern of the West are likely.

Purchase of water rights by energy companies has become a major political issue in the west, although the extent of such purchases is uncertain. The NAS study noted that it appears that all "available" water in Montana had been committed through the sale of 10-year water options to industry—mostly coal related industry—and that all but 97,000 acre feet of Wyoming Bighorn and Boysen Reservoirs had been similarly committed.[24] A Department of Interior spokesman, testifying about claims by western newspapers that all available western water had been bought by energy companies, denied that this was the case. The spokesman said: "It would be incorrect * * * to say

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[19] U.S. Department of Interior, Final Environmental Impact Statement for the Prototype Oil Shale Leasing Program. 1973. pp. III–23–25.

[20] See U.S. Senate Interior Committee, Water and Energy Self-Sufficiency, Serial 93–S1(92–87) for a compilation of some of these studies.

[21] The Rehabilitation of Western Coal Lands, op. cit., p. 6.

[22] Felix L. Sparks, Water Prospects for the Emerging Oil Shale Industry, Remarks Before the 7th Oil Shale Symposium, Colorado School of Mines, Apr. 18, 1974.

[23] See Western States Water Council, A Review of Interregional Water Transfer Proposals, June 1969, for a discussion.

[24] Rehabilitation Potential of Western Coal Lands, op. cit., p. 102.

that all the available water in either Wyoming, Colorado or Montana has been bought by utility companies." [25] The spokesman said that the Department had not developed priorities to favor water for energy over water for agriculture.

Secondary Development

The prospect of widespread western energy development, particularly constellations of energy facilities located near mining sites, brings with it the probability of intense urbanization in areas that are now rural or even primitive. In many cases, this process may result in the creation of "energy boomtowns"—something that is already happening in some western areas, and is happening on a dramatic scale in Alaska.

This kind of development occurs at such a pace and intensity that local communities are unable to plan in advance in order to reduce the impacts. As a result, there may be severe economic, social and environmental disruptions in the area. These boomtowns may in time become ghost-towns when the basic energy industry in the area shuts-down. The NAS study cautioned "* * * when the coal is consumed, perhaps by the end of the century in some areas, other means must be found to support the local economy in the affected areas."

Energy Development and the Coastal Zone

Unlike the interior Western States, the coastal zone is densely populated, and already contains a large share of the Nation's energy facilities. Like the West, however, coastal natural systems are especially vulnerable to environmental degradation. Like the West also, Federal plans for coping with the energy crisis could result in substantial increases in the number of coastal energy facilities, and stimulate substantial secondary growth and development.

The prospect for major new energy development in coastal areas carries with it substantial potential for conflict with other coastal land uses. Unlike the West, physical availability of space is often a problem in densely urban coastal areas. Coastal counties account for about one-third of the present U.S. population, and it has been estimated that as many as 200 million Americans could live within 50 miles of the coast by the year 2000.[26] Forty percent of the Nation's industrial development is located on the fifteen percent of the land that make up the coastal counties.[27]

Coastal areas are also important for recreation purposes. Consumer expenditures for ocean-oriented recreation involved an estimated $4.1 billion in 1972, a figure which is expected to grow to $8 to $10 billion by the year 2000.[28]

Coastal wetlands—long considered prime sites for industrial development—are now recognized to have great economic and environ-

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[25] Testimony of Jack Horton, Assistant Secretary of Interior, at Hearings on Federal Coal Leasing before the U.S. House Interior Insular Affairs Committee Subcommittee on Mines and Mining, Mar. 14, 1975, p. 22.

[26] Report of the Senate Commerce Committee on S. 586, The Coastal Zone Management Act Amendments of 1975 (Report No. 94–277), July 11, 1975, p. 4.

[27] U.S. Department of Interior, The National Estuarine Pollution Study, Report of the Secretary of Interior to the U.S. Congress, 91st Congress, 2d session, March 1970, Sen. Doc. 91–58, p. 28.

[28] National Ocean Policy Study, The Economic Value of Ocean Resources to the United States, December 1974, pp. 85–87.

mental value. Wetlands and estuaries provide an essential habitat for some stages of the life cycle of most commercially important fish and shellfish; play a key role in bird migrations; and have a capacity to assimilate a substantial amount of water pollution and sewage. The U.S. Interior Department estimated in 1970 that the total economic value of wetlands to coastal counties was $60 billion.[29]

The Onshore Impacts of Outer Continental Shelf Oil and Gas Development

As part of its plan to achieve greater independence from foreign oil, the Federal Government has accelerated leasing of Outer Continental Shelf land for oil and gas development. While the accelerated program has lagged behind its original schedule, the Interior Department's Bureau of Land Management held four lease sales in 1975 and expects to hold six sales annually thereafter.

Coastal States have expressed concern that the leasing program, which could have substantial onshore impacts, is being undertaken without adequate consideration of potential conflicts between the leasing program and State coastal zone management, now being conducted by all 30 ocean-fronting and Great Lakes States under the Coastal Zone Management Act of 1972.[30] The chief concern is that the development of onshore OCS support facilities and secondary development stemming from the OCS leasing will outpace State and local efforts to minimize the impact.

The potential impacts of the OCS leasing program are likely to vary greatly from region to region, depending upon such factors as whether OCS producing lands are located adjacent to coastal areas which already have petroleum processing infrastructure like oil refineries; whether the onshore area is urbanized or rural; and whether adequate planning processes are in place.

Because of uncertainties about the magnitude and location of OCS reserves, little is known about how many new onshore OCS support facilities will be needed. The Interior Department's final environmental impact statement on the accelerated leasing program noted that neither the number of facilities nor the amount of land needed for these facilities could be estimated since "these facilities are planned as the need arises, i.e. on the production estimated from exploratory drilling results * * *," and concluded that an unknown amount of land in each OCS leasing area would have to be committed to these facilities.[31]

The Council on Environmental Quality, in a study of the impacts of OCS development,[32] attempted to estimate the number of new OCS support facilities that would be needed for eight sample areas, given certain assumption about OCS productivity.

The report found new facility needs to be highly variable. For example the report estimated that if highly productive OCS land was found off South Carolina and Georgia, three new refineries, two gas processing plants and two to three petrochemical complexes would

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[29] National Estuarine Pollution Study, op. cit.
[30] Public Law 92–583.
[31] U.S. Department of Interior. Final Environmental Impact Statement on Proposed Increase in Oil and Gas Leasing on the Outer Continental Shelf. FES–75, released July 7, 1975, Vol. 2.
[32] OCS Oil and Gas—An Environmental Assessment: A Report to the Preident, April 1974.

need to be constructed in the region by 1985. By the year 2000, five to six refineries, eight gas processing plants and seven to eight petrochemical complexes would be needed. But, if the same high OCS production levels are achieved in Alaska, the likely support area—Washington's Puget Sound region—would not need any new refineries, gas processing plants or petrochemical complexes by 1985 and would only need one or two refineries and three new petrochemical complexes by the year 2000, because of the existing petroleum processing infrastructure.

Both the pace and intensity of secondary development generated by OCS development and OCS related activities would also be highly variable. The report estimated that under high OCS development assumptions, the population of the South Carolina-Georgia OCS area would nearly double between 1970 and 1985—from 336,000 to 650,000. Most of the new development would locate near Charleston, S.C.—the major metropolis in the region—and would be equivalent, the report says, to building a new city the size of Charleston in a decade.

In some areas, land needed for new on-shore facilities, and to meet the housing and other land needs of new population attracted to a region by OCS related activities, could substantially limit non-OCS development options in the future. For example, the CEQ report found that OCS development in the heavily urbanized New England study area could require 9 percent of the total remaining undeveloped land, and, more significantly, 14 percent of the undeveloped land actually suitable for general development. This land requirement, the report noted, "points to potential difficulties of future land use planning for the entire region * * *." [33] The report predicted more troublesome land impacts in the Washington Puget Sound region, which could be the processing area of Alaskan OCS oil and gas production. While new OCS related development would only require 3.5 percent of the regions remaining undeveloped land, this constitutes 70 percent of all the undeveloped land suitable for development, because most of the region is mountainous, and unsuited for most kinds of development.

CEQ's estimations of the onshore land requirements for OCS development are significantly higher than those developed by the Interior Department in its regional environmental impact statements on OCS development. There appear to be a number of reasons for this discrepancy. CEQ has been criticized by some for overestimating the number of new refining and petrochemical facilities that would be constructed as a consequence of OCS development. The Interior Department impact statements have generally assumed that existing refining capacity could handle a substantial proportion of OCS oil and gas production, and that, in any case, the refining and petrochemical facilities needed to meet any shortfall would have to be built regardless of whether the oil came from the OCS or were imported. However, the Interior Department impact statements have generally only considered land needed for industries that would serve primary OCS development, and have given little or no attention to secondary industrial, commercial and residential development that might arise from OCS development.

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[33] *Ibid.*, Vol. 4, p. 3–25.

Other Energy Facilities

A number of other kinds of energy facilities are expected to be constructed in coastal areas. Presently pending before the Federal Power Commission are seven proposals to construct and/or operate liquified natural gas importation terminals. Many of these proposed facilities would be located in populous ports like New York and Boston where a serious accident could be catastrophic. In 1973, Congress passed the Deepwater Ports Act which, for the first time, established Federal procedures for licensing offshore ports capable of accommodating supertankers. While a number of potential locations for such ports have been under study by Federal and private agencies for several years, only two applications to construct these facilities have been made. Depending on location, these major port facilities could stimulate considerable new onshore development. Finally, a substantial number of new nuclear powerplants are expected to be constructed in coastal areas in the coming years.

Electrical Facilities and Land Use

A large amount of land is presently used for electric generating facilities and associated transmission lines. Substantial additional acreage may be needed in the future, but estimates of future siting needs are highly conjectural at this time because of uncertainties stemming from the energy crisis and because of uncertainties about what kind of electrical facilities will be built in the future.

Prior to the Arab oil embargo in 1973, most forecasters assumed that electricity consumption would continue at levels near the historic average annual growth rate of about 7 percent—a doubling every 10 years—that has prevailed throughout most of the century. Figure 6, compiled from a number of sources, shows several forecasts made in the early 1970's about electricity consumption for the three decades between 1970 and 2000. All but one of the forecasts projected that consumption of electricity would increase four to six times over the consumption rates in 1970 by the year 2000.

Figure 6

ALTERNATIVE FORECASTS OF U.S. ELECTRICITY CONSUMPTION

[Trillion kilowatt hours]

Projection	1970	1975	1980	1985	1990	2000
Chapman, Mount, Tyrrell:						
High	1.53	2.14	3.05	----------	5.66	9.89
Medium	1.53	1.98	2.38	----------	3.01	3.45
Low	1.53	1.88	2.07	----------	2.11	2.01
Cornell-National Science Foundation	1.57	2.15	2.92	3.96	5.38	10.25
Dupree, West	1.53	2.13	3.00	4.14	----------	9.01
Federal Power Commission	1.53	----------	3.07	----------	5.83	----------
Hudson, Jorgenson	1.53	1.96	2.58	3.35	4.37	6.92
National Petroleum Council	1.59	2.29	3.29	4.54	----------	----------

Sources: Cornell-NSF, FPC, NPC forecasts are given in Chapman, Mount, Tyrrell (1972) table 1, p. 3. The Chapman, Mount, Tyrell "low" forecast assumes that the real electricity price doubles by 2000, the "medium" forecast corresponds to the FPC estimates of a 19 percent real price increase over 1970–90, "high" corresponds to a 24 percent real price decline over 1970–80 and a 12 percent decline over each of the 1980–90 and 1990–2000 intervals. Energy Facts II.

With higher prices for oil and other fuels in the post embargo period, and with the sluggish economy, electricity sales slackened, and utilities cancelled or delayed a significant portion of their planned capacity expansion in 1974–1975. In 1974 alone utilities cancelled or delayed construction of 106 nuclear and 129 coal-fired powerplants. These cancellations, according to *Business Week*, involved 170,000 MW of the total 360,000 MW of all planned increases in capacity. Because of the long leadtime in building a new electric facility—up to a decade from the planning stages to completion—a continuation in this trend to delay construction of facilities will mean that substantially less electricity will be available for consumption in the mid to late 1980's than was originally forecast.

A downward trend in utility 10-year forecasts has recently been noted by the Federal Power Commission. The 10-year forecasts prepared in 1975 show significant declines in anticipated growth rates when compared to similar 10-year forecasts prepared in 1974. For example, the 1974 projections anticipated a 7.43 percent annual growth rate for the decade; the comparable 1975 figure is 6.73 percent.

While uncertainty about demand projections makes estimates of siting needs for electrical facilities difficult, some of the land-use issues and requirements for nuclear power, coal-fired powerplants, hydroelectric power, and solar and geothermal power are discussed below.

Nuclear Energy Facilities

The future of nuclear power is uncertain at this time—a situation that makes it difficult to estimate future land requirements for nuclear facilities. The uncertainties stem from both economic and public safety issues associated with nuclear power production. The escalating costs of construction of new nuclear plants led to cancelling or delaying construction of 106 nuclear plants in 1974. Growing opposition to nuclear power by some public interest and environmental groups which stems from concern about the operational safety of nuclear plants; the disposal of nuclear wastes, and possible theft of nuclear materials for use in terrorist activities, may also be contributing to the reluctance of utilities to order new nuclear plants. Postponement of nuclear power until safety issues are resolved will be one proposition on California's 1976 primary ballot.

Hence, it is unlikely that earlier nuclear industry forecasts of 500 to 1,000 nuclear reactors in operation by the year 2000 will be realized. Indeed, President Ford, a proponent of nuclear development, set a national goal of 200 nuclear plants in operation or under construction by the year 1985—only 74 more than in 1975. Presently, there are only 55 operating nuclear powerplants in the United States. An additional 76 facilities are in various stages of construction. One hundred twenty-two facilities are in the planning stage.

In addition to nuclear reactors themselves, a number of associated facilities—enrichment plants, plutonium reprocessing plants, radioactive waste disposal facilities, and the like—will be required in order to support the nuclear reactors.

Nuclear power plants are heavily concentrated in coastal areas, and are usually placed adjacent to major water bodies, where sufficient

water is available to cool nuclear reactors. There could be a great increase in coastal nuclear facilities if floating nuclear powerplants, now being commercially offered, are widely bought by utilities. These facilities, which would be moored off coastal shores, would be built according to standardized design, and presumably would be easier to site than their land based counterparts.

Other kinds of nuclear facilities, however, may be located in inland areas. There are a number of land use issues and problems associated with nuclear facility siting. Among them:

1. URBAN GROWTH IN CLOSE PROXIMITY TO A NUCLEAR PLANT

Nuclear Regulatory Commission regulation of nuclear plant siting requires that the plants, for public health and safety reasons, be located in low density population areas. There are, however, no Federal regulations requiring that low density population be maintained after the plant is sited. In other words, while a nuclear plant cannot be sited in a populous area, urbanization after the plant is constructed may bring population to levels beyond those permissable when the plant was originally sited. This may become a serious problem in the future as many nuclear plants are anticipated to be placed in the densely populated coastal areas of the country, where competition for land is intense. Most States do not have land use regulations in effect that are designed to limit population growth in areas adjacent to nuclear powerplants. An exception is California, where the State's Energy Resource Conservation and Development Act requires utilities to purchase land adjacent to energy facility sites upon which increased population density might in the future pose a threat to public health and safety. If local governments in the area are already practicing land use controls which would preclude such population densities, the utility would not need to purchase the land. Any change in the existing local regulations, however, could be reviewed by the State energy commission to insure that safe population densities would be maintained. Should other States follow California's example, perhaps taking the idea one step further by requiring municipalities to zone out new development around nuclear installations, the inherent conflicts of plant siting and land use and economic effects come into sharp focus. Usually, powerplants are perceived as enhancing economic growth. It might work out that quite the opposite would be the case.

2. FINDING A PERMANENT STORAGE SITE FOR NUCLEAR WASTES

One unresolved nuclear safety issue concerns disposal of radioactive wastes generated by nuclear power—particularly plutonium waste. Plutonium is a virulent cancer-causing agent, and one of the most explosive substances known. By Energy Research and Development Administration standards, plutonium would need to be stored for nearly 500,000 years before its radioactivity would reach acceptable standards. Presently, nuclear wastes are being stored in underground storage tanks, but there have been proposals for construction of above ground storage facilities to accommodate the increasing volume of nuclear wastes, while ERDA searches for an appropriate permanent disposal site and methods for disposal.

Such a permanent disposal site would need to be "geologically secure" for 200,000 to 500,000 years. Even so, however, unforeseen factors could result in the release of some materials. For example, plans by the AEC, predecessor of the Energy Research and Development Administration, to utilize an abandoned salt mine in Kansas to demonstrate a technique for creating a permanent disposal method had to be abandoned in 1972. It was discovered that drilling above the mine could have jeopardized the capacity of the site to keep water away from the wastes. A conclusion that could be drawn from this incident is that some kind of land-use planning process must be created which not only deals with geological considerations, but with the capacity of future governments to prevent human interference with disposal sites for a time period several hundred times longer than the life of any previous civilization on the face of the earth.

In fact, temporary storage of wastes underground requires an extraordinary degree of planning and technical skill. Accidents can happen. In 1973, 115,000 gallons of radioactive wastes from a storage facility in Hanford, Wash., seeped into the ground from an undetected leak. While extensive contamination of surrounding areas was avoided, the leak—and other similar accidents—point out the risks inherent in storing such products in liquid form and the virtual impossibility of using current planning theory to deal with a range of eventualities impossible to predict.

3. NUCLEAR POWER PARKS VERSUS DISPERSED SITES

Considerable attention has been given in recent months to the nuclear power park concept. Such a "park" would include multiple nuclear reactors and possibly other nuclear facilities involved in the nuclear fuel cycle. By dispersed-site standards, a nuclear power park would have enormous generating power and would require enormous amounts of land as well. A single park could involve 40 to 60 thousand acres, an area about 1.5 times the size of the District of Columbia.

One benefit to energy developers is the fewer number of sites that would be required. Presently, about 200 nuclear sites have been secured for dispersed facilities. Without nuclear parks, according to a General Electric Company study,[34] dispersed siting needs could double every decade. With nuclear parks, siting needs would be substantially reduced. The assumption is that a nuclear park site would only have to be approved once. Thereafter, separate approvals of sites would not need to be made for each new facility built at the park.

A public benefit proposed for nuclear parks is that greater security against theft of nuclear materials or terrorist attack could be achieved than at dispersed sites. Since dispersed siting of nuclear facilities requires considerable transportation of nuclear materials between facilities, the chance of hijack or accidents may be greater with dispersed sites than at a power park which includes most facilities that service the nuclear fuel cycle. Also, a larger security force could be provided at a power park than at a dispersed site.

However, the safeguards issue cuts both ways. The concentration of facilities at one site could in fact attract terrorist activities, since the

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[34] Center for Energy System, General Electric Company, Assessment of Energy Parks vs. Dispersed Electric Power Generating Facilities. Final Report. May 30, 1975.

advantages to be gained would be so much greater. A successful theft could yield more plutonium at a power park than at a dispersed site. Also, since a single nuclear park might provide much of the electricity for an entire region, a successful terrorist attack on major transmission lines coming out of the park could literally black out a region of the country for an indefinite period. Again, as in the case of plutonium waste disposal, planning procedures would be required for which there is little, if any precedent.

A key land use question pertaining to nuclear power parks would be its impact on surrounding areas. By its very nature, a power park would presumably be located in an isolated area. Much more new population would be attracted to the area than at a dispersed site, and secondary growth problems could be severe. In the 1940's, for example, the effort to develop the atomic bomb resulted in three new cities, Oak Ridge, Los Alamos, and Hanford, Wash. There is presently no Federal requirement that urban growth be limited around nuclear facilities, even though plants must be located in low density areas. Secondary growth around a power park is likely to be a more serious problem than at a dispersed site because: (1) There are more nuclear facilities at a power park, and hence a greater chance of an accident; and (2) a densely populated area adjacent to a facility could make security more difficult to maintain.

4. DECOMMISSIONING OF NUCLEAR PLANTS

The question of what to do with a nuclear reactor once it has ceased operations has only recently received much attention, and has generally not been a consideration in the siting of new plants. It is clear, however, that the radioactive parts of a reactor structure can not simply be left unprotected. Possible decommissioning alternatives include: (1) Cordoning off the site and keeping it permanently secure in order to prevent public trespass; (2) dismantling of the radioactive parts of the facility, and subsequent disposal of these parts in a specially secured nuclear dump—this would of course require reservation of land somewhere for this disposal purpose; and (3) burial of the radioactive parts on site, with continued security arrangements.

Any of these three options would have a significant effect on land use, and would require new constructs for planning decisions that would have implications so far into the future that they are impossible to perceive.

Hydroelectric Facilities

A hydroelectric dam and reservoir generally requires more land than any other kind of electric generating facility. A typical impoundment may require 1,000 to 20,000 acres, and some are far larger. However, since hydroelectric impoundments may be used for many purposes—including flood control, irrigation, and public recreation, electric power generation is seldom, if ever, the sole purpose of an impoundment. Furthermore, unlike coal burning or nuclear powerplants acreage figures for hydroelectric facilities reflect the land covered with the primary energy resource—the water.

Since hydroelectric resources are renewable—at least until siltation ends the effective use of the resource—a long-lived hydroelectric fa-

cility may not actually require much more land than a coal powerplant fed by surface mining over a comparable period.

The total hydroelectric potential of the United States has been estimated to be 390,000 MWh electric capacity. Engineering constraints, however, cut the figure in half. Of this, however, only about 170,000 MWh are considered to be recoverable through present-day engineering.

By the end of 1970, total installed hydroelectric capacity was estimated to be 51,900 MWh. (See fig. 7.) While precise figures on the amount of land presently utilized for hydroelectric purposes are not available, the area is probably in excess of 10 million acres. The Federal Energy Administration, in its draft Environmental Impact Statement on the President's proposed Energy Independence Act, estimated that up to 20 million acres could be utilized for hydroelectric purposes by 1985.

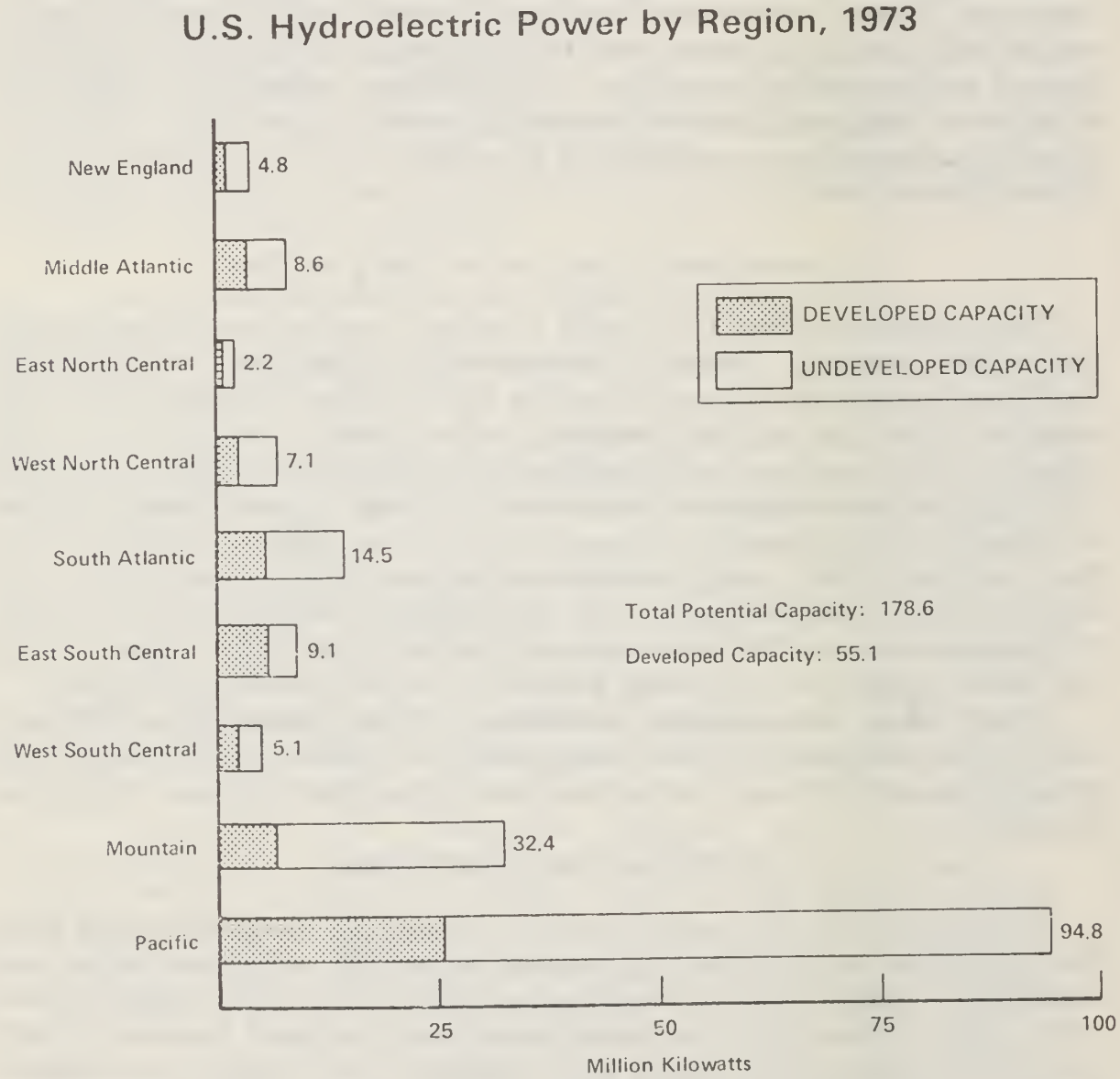

FIGURE 7

Source: Federal Power Commission, 1974.

Coal-Fired Powerplants

Figure 8 shows major coal and oil fired powerplants in 1971. As a consequence of decreased reliability of foreign oil supplies, there may be widespread conversion of existing oil-fired powerplants to coal. There may also be a substantial increase in the number of new coal fired plants. President Ford has set as a national goal of 160 new operating coal-fired plants by 1985.

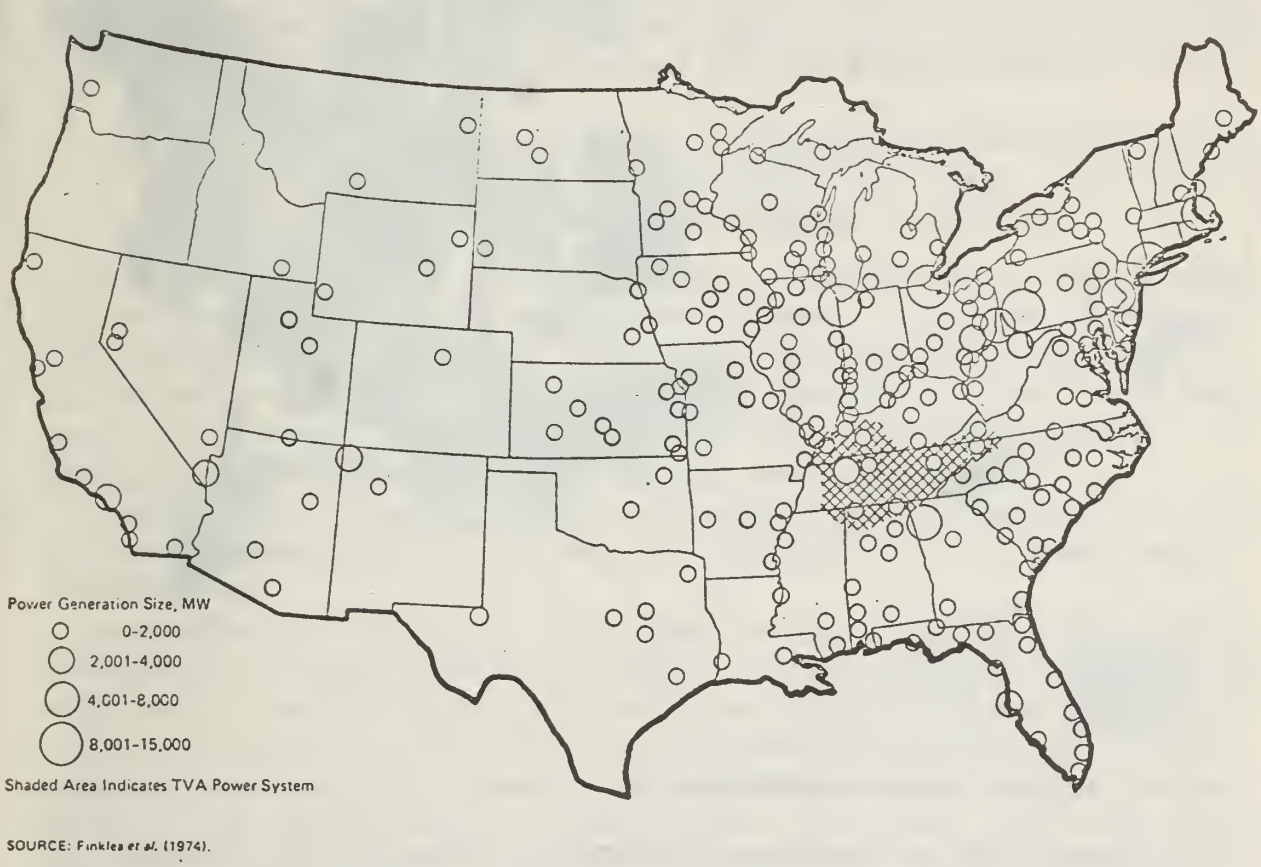

Figure 8.—Location of major coal- and oil-fired power units, 1971.

An important consideration in the siting of a large number of new coal-fired powerplants is possible damage to crops, building structures, and public health because of increased air pollution, not only to the local area but to distant regions. Long range transport of air pollutants, with subsequent deposition in distant areas—frequently 1,000 or more kilometers away—has long been recognized to be a severe air pollution problem in Scandinavia, which receives a substantial portion of sulfur oxide pollutants from Continental Europe's industrial centers. These pollutants have fallen out as highly acidic rainfall, and are reported to have adversely affected aquatic life and forest growth and to have resulted in corrosion of building structures.

Increased acidity of rainfall has recently been noted in the United States—see figure 9—primarily the Eastern United States. In much of the East, the average acidity of rainfall is estimated to be 100 times greater than it was several decades ago. Since the problem has only recently been noted, there is little certainty about the effects—but the problem is potentially great.

FIGURE 9.—Acidity of rainfall in the United States in the period 17–31 Mar. 1973 (ANON 1974). The map is based on a survey conducted by 16,000 high school students at 1,100 stations, using a method accurate to ±0.5 units or better.

Source : National Academy of Sciences.

The impact of air pollutants on crop productivity is becoming increasingly apparent. A 1974 field experiment in Riverside, Calif., for example, found that crops exposed to pollution in the area produced significantly reduced crop yields when compared to the control crops. For alfalfa, there was a 38 percent decline in production; for black-eyed beans—32; lettuce—42; sweet corn—72; and radishes—38 percent reduction.[35] Similarly, a comparison of annual ring growth in similarly aged groups of ponderosa pines in the San Bernardino mountains of California during the relatively unpolluted 30-year period between 1910 and 1940 and the more polluted years between 1944 and 1974, showed, that, after adjusting for climatic variability, 20 board feet of merchantable wood was produced per tree between 1910 and 1940 whereas only 5 board feet were produced between 1944 and 1974.

A recent review of research on acid rain by the National Academy of Sciences noted that there is increasing evidence that acid rain may harm vegetation, aquatic communities and possibly soils. Some of the specifics:

—studies in Sweden and northern New England have found reductions in forest growth to be correlated with acid rain;

[35] Statement of Dr. Clifton Taylor, Statewide Air Pollution Research Center, University of California, at Hearings held by House Committee on Science and Technology, Nov. 12, 1975.

—pine and spruce trees in the vicinity of coal-fired powerplants have shown a number of growth abnormalities that have been attributed to acid rain.
—laboratory experiments with simulated acid rain has shown damage to some species of flowering plants; and impeded leaf tissue development in yellow birch seedlings;
—acidification of lakes has resulted in declines in certain fish species, and in some cases the disappearance of some species from the lakes. Furthermore, certain kinds of algae and zooplankton have been eliminated following acidification of Swedish lakes.
—acid rain and snow may leach out important ions from the soil. One Norwegian study indicates that acid rain may remove calcium, an essential plant nutrient, from the soil.[36]

While less is known about the effects of acid rain in the United States than in Scandinavia, another National Academy of Sciences study prepared for the Senate Public Works Committee estimated that the annual cost of acid rain in the United States in terms of crop damage, fish damage, and damage to buildings was $500 million. Far greater costs in terms of human health were also noted.[37]

Possible crop damage from coal-burning powerplants may be an important consideration in the construction of new "mine-mouth" powerplants.

As previously indicated, some utilities are locating coal-burning plants close to coal mine sites in order to minimize coal transportation costs, and to avoid stricter air pollution control requirements which may be in effect in urban areas. Particularly intense siting of powerplants is expected in the interior western states, which have large quantities of low sulfur coal—this coal is also low grade fuel, with lower Btu content than eastern coal. Hence, more of the coal needs to be burned to produce the same amount of electricity. Intensive development of western powerplants could result in transport of SOX to the Midwestern States—the breadbasket of the world. Figures 10 and 11 show FEA's estimates of increased SOX and particulate pollution under varying Project Independence scenarios.

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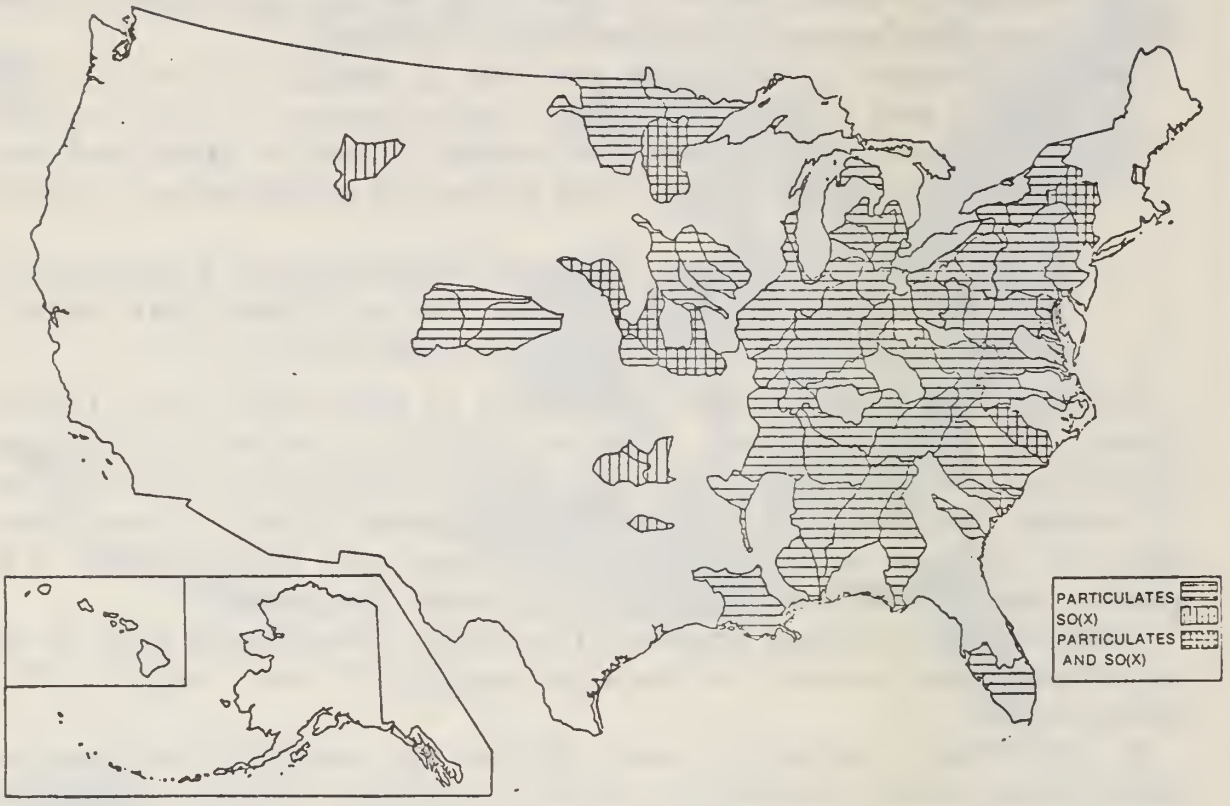
[36] National Academy of Science, Mineral Resources and the Environment, Washington, D.C. 1975, pp. 239–240.
[37] National Academy of Science, Air Quality and Stationary Source Emission Control, Prepared for the Senate Public Works Committee. 94th Congress, 1st Session. Serial No. 94–4. Mar. 1975, p. 624.

FIGURE 10

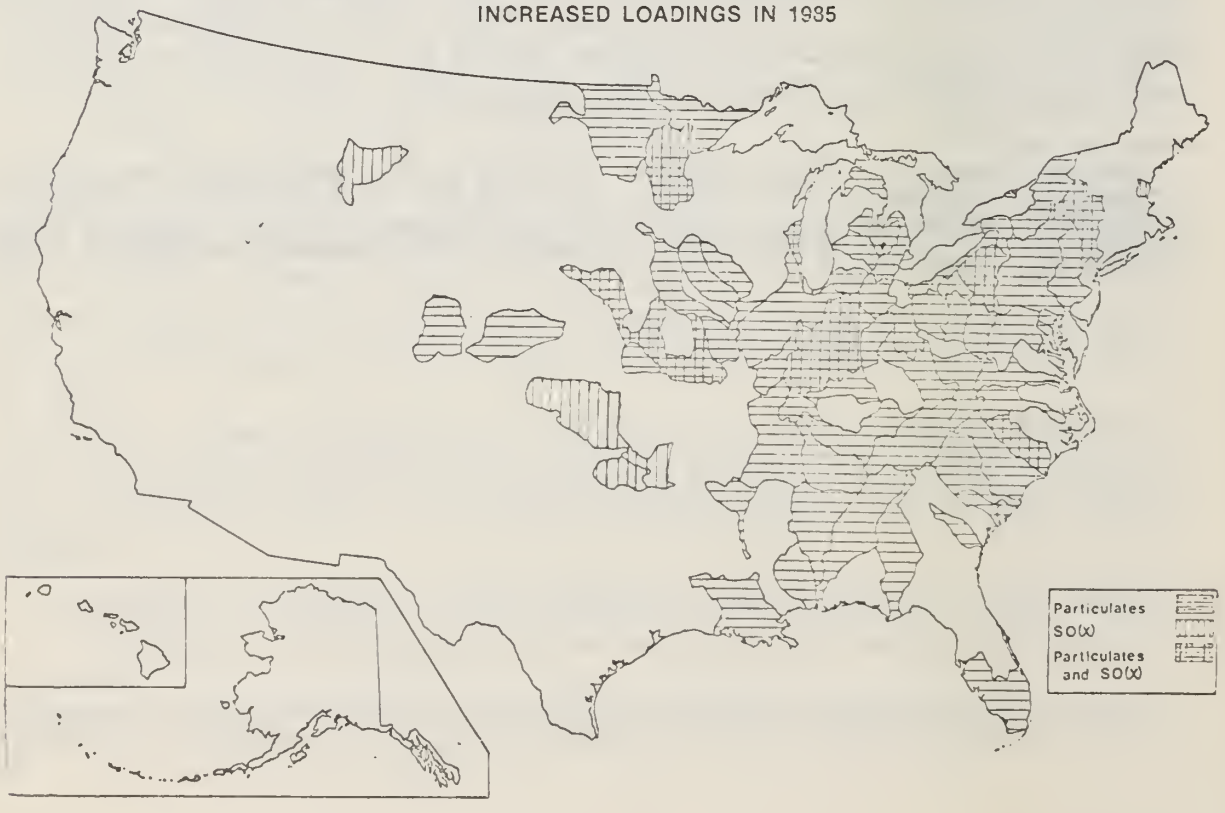
BUSINESS AS USUAL
SO[X] AND PARTICULATES
REGIONS EXCEEDING PRIMARY STANDARDS IN
1972 AND INCREASED LOADINGS IN 1985



Source : Project Independence Report.

FIGURE 11

ACCELERATED SUPPLY
SO[X] AND PARTICULATES
REGIONS EXCEEDING PRIMARY STANDARDS IN 1972 AND
INCREASED LOADINGS IN 1985

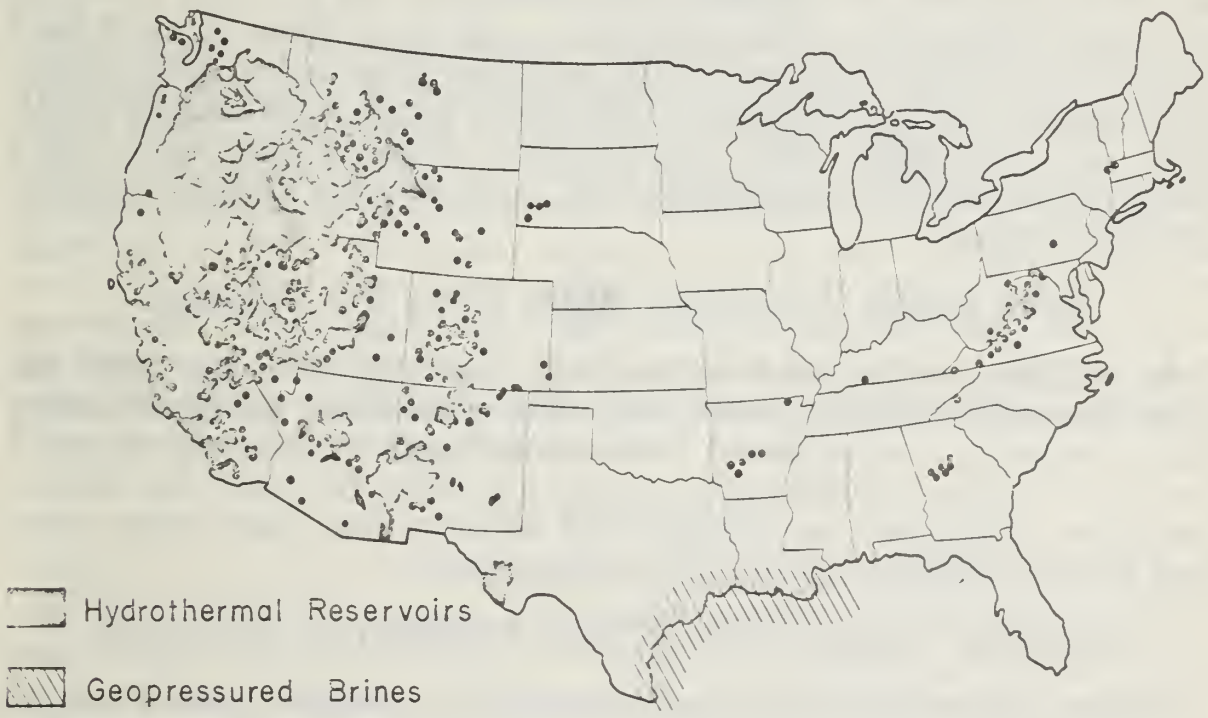


Source : Project Independence Report.

Solar, Geothermal Energy

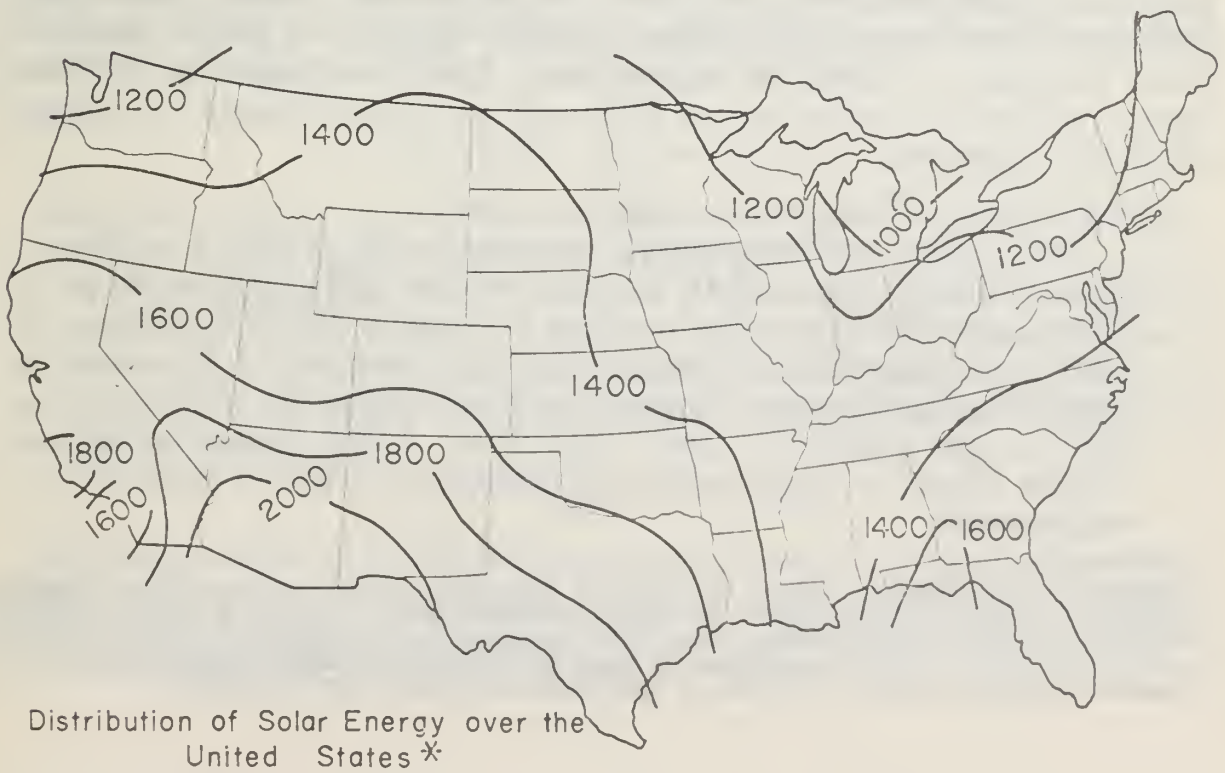
Solar and geothermal energy are two alternative sources of energy that many feel will become important contributors to the Nation's energy supply around the year 2000 if not earlier. The Energy Research and Development Administration has projected that solar energy could provide a moderate contribution in that time period. Figures 12 and 13 show located geothermal fields and solar energy potential across the Nation respectively.

FIGURE 12.—Distribution of Geothermal Resources.



Source: Energy Alternatives.

FIGURE 13.—Distribution of U.S. Solar Energy.



Source: Energy Alternatives.

While geothermal energy is often considered a clean energy source, it does have some adverse environmental impacts on land and land use. The chief land impact would stem from land subsidence around geothermal wells, with possible increases in seismic activity. While subsidence could be reduced by reinjection of spent waste waters, little is known about the effects of this waste disposal technique.

Solar energy, could have a greater impact on the land—particularly in the Southwestern United States where solar potential is greatest. Project Independence estimated that 10 square miles would be required to generate 1000 Mwh of electricity, through a solar thermal system while a photovoltaic solar system would require 40 square miles for an equivalent amount of electricity. However, not all the land would be occupied by the solar collecting devices, and some other kinds of land uses, such as cattle grazing, could continue. Also, solar energy technologies are expected to improve in the near future, particularly small-scale and community level applications—which could reduce land needs to the point of negligibility and quite possible increase land use planning options.

Some Other Facilities—More Land Use Problems

In addition to the land-use impacts discussed thus far, there are some important impacts associated with some other kinds of energy facilities which are expected to be constructed in the coming years. Some of the most illustrative examples include facilities for the importation of liquified natural gas; new oil refineries; deep-water ports; coal slurry pipelines; and synthetic fuel plants.

Liquified Natural Gas (LNG) Importation Facilities

About seven proposals to construct and/or operate liquified natural gas importation terminals are now pending before Federal agencies. The facilities are designed to store the enormous increases in LNG importation which was projected for the 1973–80 period by the Federal Power Commission. Some of these facilities would be located in densely populated port areas such as New York City and Boston. Significant questions have been raised about possible dangers to public safety if these facilities are sited in urban areas. LNG accidents, in the past, have resulted in major loss of life, and have significantly disrupted settlement patterns.

FEA's Project Independence Report noted:

> The major environmental concerns with LNG are the human health and safety impacts of an LNG spill or fire. There have been two major fires to date in LNG facilities. The first occurred in Cleveland in 1944, where over 100 people were killed and severe damage was done to the city sewer system, as gas exploded inside the pipes. A fire in an empty Staten Island storage tank in February 1973 killed about 40 employees.[38]

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[38] Project Independence Report, op. cit., p. 213. Interestingly enough, the technical appendix to Project Independence on energy facilities takes a rather sanguine attitude towards LNG. The appendix notes: that "LNG possesses no peculiarities—other than coldness—which make it more hazardous to store or handle than other hydrocarbons." The technical appendix makes no mention of the accidents cited in the main report.

A Federal Power Commission environmental impact statement on a proposed LNG terminal for Staten Island analyzed possible risks to inhabitants of the New York region. The study found that 807,000 people live in a "risk corridor" adjacent to the barge path which would be used in transporting LNG to the facility. While the study did not estimate fatalities in the event of a major accident, presumably thousands or even hundreds of thousands of people could be killed or maimed, since a major LNG release could result in a several square mile vapor cloud, and since population densities of up to 100,000 people per square mile characterize parts of the risk corridor.

Deepwater Ports

Enactment of the Deepwater Ports Act of 1974, which establishes Federal procedures for licensing deepwater ports on the Outer Continental Shelf, is expected to result in at least some deepwater ports being constructed in the next decade or so. These ports are designed to accommodate super-tankers, which presently cannot be docked in American harbors. The chief impact of these ports in terms of land use will be on shore facilities needed to service the ports, and secondary growth and development. As with Outer Continental Shelf oil and gas development, the magnitude of the impacts will depend largely upon existing onshore facilities, population base, and planning capacities of State and local governments in the area.

Oil Refineries

There are presently 247 refineries in the United States, with a capacity of 14.2 million barrels per day. Presently, 9 new refineries are under construction, and about 36 existing refineries are either being expanded or rehabilitated. Twenty-five new oil refineries are in the planning stage. A major siting consideration in the construction of oil refineries is impact on air quality. FEA estimates that a 200,000 barrels per day refinery would exceed ambient air quality standards for hydrocarbons 10 to 20 percent of the time, in the immediate vicinity of the plant—even if no other hydrocarbons are emitted in the area. FEA noted that even 6 miles from the refinery, the ambient air quality standards would be exceeded 5 percent of the time.[39]

Synthetic Fuel Plants

Conversion of coal to synthetic fuel on a major scale has been proposed as a means to achieve greater utility of coal resources. Presently, about 10 synthetic fuel facilities are in the planning stage. Such facilities could adversely affect air quality, and, if placed in the Western States, could reduce water supplies in some river systems. As with any major facility, a synthetic fuel facility could stimulate substantial secondary growth.

Coal Slurry Pipelines

Transportation of coal from the mine site to powerplants has traditionally been done by railroads. In recent years, however, coal slurry

[39] Project Independence Report, op. cit. p. 204.

pipelines, used to transport pulverized coal in water, have been proposed in some areas of the country. In Arizona, a 270-mile coal slurry pipeline is presently being used to transport coal from a Black Mesa mine to a powerplant. Other coal slurry pipelines, including a 1,000 mile line that would carry coal from Wyoming to Arkansas, have been proposed.

The direct impact of a coal slurry pipeline on land resources is generally considered minimal: the line is buried, and the only surface facility required is a pumping station every few miles. The indirect impacts could be great, however. For one thing, slurry pipelines require considerable quantities of water. Removal of such water from Western States, where water is scarce, could affect other land uses such as agriculture, and future regional development patterns. Furthermore, coal slurry pipelines could adversely affect railroads and other industrial uses that are dependent upon railroads.

CHAPTER III.—LAND AND ENERGY PLANNING AT THE STATE LEVEL*

Several States have developed land use planning, coastal zone management, and energy facility siting programs in the last half decade. While these new State programs only partially integrate land and energy decisionmaking, the administrative machinery they have set in place provides a good foundation for more fully integrated planning in the future.

The following discussion is divided into two parts. Part I summarizes State-level planning efforts in terms of statewide planning, and energy facility siting. Part II provides detailed analysis of energy facility planning legislation from four States, California, Montana, Maryland, and Minnesota.

State-level Planning

COASTAL ZONE MANAGEMENT

Because of the enactment of the Coastal Zone Management Act in 1972,[1] the opportunity for coordinating and integrating land and energy decisionmaking is presently greatest in coastal areas. This act provides a framework for resolving conflicts among local, State and Federal interests under the framework of State coastal zone management programs. Since it is also a comprehensive planning program, it provides a vehicle for integrating energy facility siting decisions with overall State coastal zone planning priorities.

All 30 coastal and Great Lakes States are developing coastal zone programs under the act's grant provisions. Once these programs are approved by the Secretary of Commerce, the administrator of the act, Federal agency activities have to be consistent with the approved program to the extent feasible, except when the Secretary determines that national security requires otherwise. Many observers think that this so-called "Federal consistency" provision—unique in Federal law—will eventually give State governments major new powers over the activities of Federal agencies. It is presently untested, however, since no State program has yet been approved.

If the act will indeed give States new leverage over Federal activities, it also provides some assurance to Federal agencies that "national interests" will be reflected in State programs. For one thing, as already mentioned, the "Federal consistency" provision is subject to override in those cases which the Secretary of Commerce determines the national security so requires. Furthermore, State management programs must provide for "adequate consideration of the national

*This chapter was prepared by W. Wendell Fletcher, Analyst in Environment and Natural Resources Policy, Congressional Research Service. Sections in this chapter pertaining to State legislation concerning siting are drawn from W. Wendell Fletcher, Energy Facilities Siting, a CRS Multilith, 1975.

[1] Public Law 92–583.

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interest in the siting of facilities necessary to meet requirements that are other than local in nature." Given the reluctance of some localities to approve new energy facilities, this provision is felt by some to be a step toward giving the Federal Government a kind of *de facto* override of local and State siting decisions. Interestingly enough, upon the preliminary submittal of two State coastal zone programs to the Commerce Department for approval, both FEA and ERDA found the programs inadequate from an energy development perspective. For example, FEA indicated that the State plans should specifically designate areas for energy development.[2] Neither energy agency has veto powers over the State programs, however.

With the increasing recognition of the importance of the coastal zone in energy decisionmaking, amendments to the 1972 act have been proposed [3] to provide greater emphasis upon energy facility planning, and to develop closer cooperation between State and Federal agencies in energy matters which affect the coastal zone. A major reason for the legislation is the conflict over the Federal Government's acceleration of leasing of Outer Continental Shelf oil and gas lands. Most coastal States have argued that the leasing program should be postponed until State coastal programs are approved by the Commerce Department, or at least delayed until the States have time to develop measures to ameliorate onshore impacts of the leasing program.

There seems little doubt that energy facility development has become the major political issue in coastal zone management at this time. Conflicts about coastal energy facilities have been persistent. Some examples: Delaware's legislature, in 1971, banned new heavy industrial development from the coastal zone following proposals to construct a major new oil refinery and an artificial coal storage island. Durham, N.H., citizens rejected a proposal to construct an oil refinery at a 1973 town meeting. A subsequent attempt to override the local decision in the State legislature failed. In 1975, California's legislature passed a law prohibiting new pipelines from entering State waters through 1978, or until the State's coastal zone program is approved by the Secretary of Commerce.

STATEWIDE PLANNING

Several States, including Hawaii, Vermont, Maine, Florida, Oregon, and Nevada, have recently developed statewide land use planning processes. Although each State program is different, all of the programs involve a partial reassertion by the State of land use regulatory authority traditionally delegated to local governments. Nearly all of the State programs authorize State involvement in major land use decisions—those decisions that are considered to be of more than local concern. Some of the State programs also authorize State involvement in planning and regulating areas of critical State concern—land that, because of environmental factors, natural hazards or other reasons, needs to be developed in an especially careful manner.

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[2] See "Energy and the Coastal Zone: Pulling and Hauling Among the Feds," by Luther G. Carter, *Science*, June 27, 1975, for a discussion.

[3] See S. 586, which was passed by the Senate on July 17, 1975, and H.R. 3981, a somewhat similar house bill. Over 50 bills pertaining to OCS development and the coastal zone have been introduced in the 94th Congress.

In many cases, the siting of energy facilities is not included in State land use programs if the State already has an energy facility siting program. Many States have energy facility siting laws—which often apply only to powerplants and transmission lines—that are designed to expedite the siting of energy facilities. Because siting programs generally involve single purpose planning, there is considerable chance for conflict with comprehensive planning under the State land use law.

Unlike the coastal zone, where administrative machinery is being developed to handle conflicts between the States and the Federal Government over energy development, there are no adequate procedures for integrating and coordinating State and Federal decisions relating to energy development and land use. Since Federal energy decisions about energy resources on Federal lands could have major adverse affects on surrounding regions, there is a likelihood of an increasing number of conflicts between the States and the Federal Government unless such procedures are developed soon.

Two land use bills introduced in the 94th Congress—S. 984 and H.R. 3510—propose to provide such procedures. The overall philosophy of the two bills is similar to that of the Coastal Zone Management Act.

S. 984, The Land Resource Planning Assistance Act, would establish a voluntary system of Federal grants, to be administered by the Department of Interior, to assist States in developing and implementing land resource programs, and would also encourage States to develop energy siting programs compatible with their land and water resource planning.

S. 984 requires States seeking grants five years after enactment to have an operating energy facility planning program as a part of their land use program. (H.R. 3510 has less detailed requirements for energy facility planning.) The Senate bill envisions the establishment of an office of Land Resource Planning Assistance in the Department of the Interior to administer a $800 million, eight year, land resource planning grant program. The grants would be used by the States to develop land resource and energy facility planning programs which include the establishment of a State land use planning agency, inventory and data collection programs, methods to induce public participation, and authority to implement the program. A State choosing to participate in the grant program would be required to develop a program to regulate land sales and development projects in predominantly rural areas and to (1) control development and guide land use in areas of critical State concern, (2) guide land use in areas impacted by key facilities, (3) control large-scale development, (4) influence location of new communities, and (5) promote continued use of food and fiber lands.

The energy facility planning provisions of S. 984 require States participating in the grant program to develop coordinated review and approval processes at the State level for new energy facilities. The energy planning program is to be compatible with State land and water resource planning. The Federal Energy Administration, not the Interior Department, is given responsibility to review and approve the energy planning element of the State land resource program.

Similar in many respects to S. 984, H.R. 3510 requires participating States to develop land use programs which include a statement of

policies defining the State's role in land use decisions and procedures for planning or regulating key facilities, large scale subdivisions, developments of regional impact and areas of critical State concern. The State program is also to include policies and procedures to promote continued use and productivity of prime food and fiber producing lands, and policies and procedures to encourage land use patterns designed to conserve energy. H.R. 3510 also requires Federal public land agencies to develop and maintain land use plans for areas under their jurisdiction.

Both bills would require Federal agency activities significantly affecting non-Federal land to be consistent with State land use programs.

STATE ENERGY FACILITY SITING LAWS

About eighteen States have recently developed energy facility siting programs. The jurisdiction of the programs seldom extends beyond electric powerplants and transmission lines, although two or three of the most recent programs may include other kinds of energy facilities such as coal gassification plants. With two or three exceptions, the primary purpose of the State programs is to expedite the siting of powerplants. To accomplish this end, most of the programs authorize override of environmental standards, and local decisionmaking to insure the siting of facilities deemed necessary by the State siting agency. In general, the siting programs are not concerned with the secondary growth that major energy facilities tend to stimulate. Some of the basic characteristics of the State siting programs are described below.

CONSOLIDATED REVIEW AND APPROVAL OF NEW FACILITIES

Streamlining of State review and approval of proposals to construct new powerplants is a key feature of all of the new State siting laws. In States that do not have siting programs, literally dozens of permits, licenses or other approvals by separate State agencies must be secured before a new facility can be constructed. This multiple approval process has been characterized by the utility industry as needlessly time consuming; expensive; and in some cases duplicative. All of the recent State powerplant siting acts consolidate at least some approval requirements. In some States, "one-stop-shopping," giving the State siting agency sole authority to approve or disapprove proposed projects, has replaced multiple approvals. In most cases the siting authority is also authorized to override environmental standards and other requirements if the agency determines that such an action is necessary to site a facility considered needed by the agency.

STATE OVERRIDE OF LOCAL ZONING

Most of the new State powerplant siting laws suspend local zoning regulations and other local requirements in so far as they apply to powerplants or transmission lines. The Nation's traditional land-use regulatory authority tends to have only an advisory role on powerplant siting decisions.

FORECASTING OF ELECTRICITY NEEDS AND SITING NEEDS

All of the State programs require utilities to make long-term forecasts of energy demand and new site needs, but the method involved varies substantially. Some of the more comprehensive State laws require independent State projections of energy siting needs; a preliminary State inventory of acceptable sites; and, in one instance, State acquisition and reservation of sites for future facilities.

CONSIDERATION OF ENVIRONMENTAL AND LAND USE FACTORS

There is a great deal of variation among the State programs about environmental requirements. In all instances, minimization of adverse environmental impacts is a stated objective of the law. However, some States permit loosening of environmental regulations if necessary to expedite siting of needed facilities, while other States require air and water pollution requirements to be met in full. All of the new State programs require consideration of alternative sites for new facilities, with an analysis of relative environmental costs of each site. The degree to which coordination and conformity of energy facility planning with other land use planning is required also varies from State to State.

Energy Siting Programs in Four States

Despite the high incidence of state siting legislation, only a few states have developed relatively comprehensive energy siting programs. These programs include requirements for energy planning by the state and the utilities. Perhaps the chief distinction between these programs and the other state energy facility siting laws is the degree to which the state itself participates in the advanced planning of facility siting. Four of the most comprehensive State energy siting programs are discussed below.

CALIFORNIA

Enacted in May 1974, the California Energy Resource Conservation and Development Act [4] is probably the most comprehensive state energy facility planning act. A major purpose of the Act is to factor energy conservation into the energy development equation, and to provide the institutional means for implementation of energy planning.

The law was preceded by a major report on California's energy situation, prepared under contract by the Rand Corporation for the California legislature, the General Assembly. The report, published in September 1972, had an important influence on the scope and nature of the legislation.

The assessment recommended, among other things, that the state itself "formulate and employ measures to slow the growth in the demand for electricity." Recognizing the inevitability of an increased demand for electricity, the report suggested that, even if the state's eight percent annual growth in electricity demand could be reduced to

[4] Cal. Pub. Res. Code. §§ 25000 *et seq.* (West Supp. 1975)

a level of three percent per year, there would still be a substantial need for new sites for electric facilities in the next three decades.

The report recommended, therefore, a greater state role in siting of facilities to be coupled with long range planning to reduce the growth of demand, and to minimize adverse impacts. State oversight would be accomplished through:

> (1) The establishment of a state agency with the power to prevent arbitrary delay in siting needed facilities by state and local agencies; the capacity to verify the need for new facilities; and the power to coordinate or manage planning.
>
> (2) Overall state guidance in planning the siting of new faciilties. The report envisioned an "interactive planning process" involving the state, the utilities and the public; state selection of sites at least four years in advance of construction, preceded by three years of site evaluation; early and continuous public participation in the planning process; and an interim strategy to deal with the transition period in which some applications for facility siting would already be in the process of consideration under the previous system.

The report found a need for energy facility planning to be integrated into a broader planning perspective than that likely to be provided by a siting program alone. In addition to comprehensive energy planning, the report foresaw a need for a greater state role in land use planning:

> There is a need for a statewide land-use policy (and an entity to manage and regulate it). Decisions on powerplant siting are closely related to questions of equitable land use. In the absence of a comprehensive policy, it will probably be necessary to prepare interim state criteria for those aspects of land use that directly affect siting, in order to provide a basis for resolving conflicts with local zoning authorities.[5]

As enacted, the California statute establishes a five member, gubernatorially appointed and state Senate-confirmed Energy Resources Conservation and Development Commission. (ERCDC). In addition to the public members, the Secretary of the State Resources Agency and the President of the Public Utility Commission serve as nonvoting, ex officio members of the Commission.

Conflict of interest provisions are specified in the Act; no persons receiving a substantial portion of their income two years prior to appointment from an electric utility or a manufacturing firm supplying a utility would be eligible to serve on the commission, and appointed members of the commission cannot be employed by a utility or related manufacturing industry until two years after they leave the commission. Similarly, commission members and employees are prohibited from participating in proceedings pertaining to firms with which they were previously affiliated. Violation of the conflict of interest provisions is a felony, with possible penalties of a $10,000 fine or imprisonment for two years, and commission members are required to post a $25,000 bond conditioned upon faithful execution of duties.

While the regulatory provisions of the Act apply primarily to electrical facility siting and certification, the Act also calls for develop-

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[5] Ibid., p. xiii.

ment of an energy resources conservation program and the formulation of an energy research and development program. These two programs follow closely the Rand Corporation's recommendation that siting of electric facilities should be carried out within the context of a broader energy policy context providing for consideration of other forms of energy, and facilitating interaction and integration of energy policy with state policies on land use, environmental quality, transportation, and urban planning.[6]

The energy conservation program [7] established by the Act, will include regulation of lighting, insulation, climate control systems, building design and construction in order to increase the efficient use of energy.

These regulations are to be implemented through local subdivision regulations.

Under the conservation program, standards are to be developed specifying minimum levels of operating efficiency for appliances that consume a significant amount of electricity.

For electric utilities specifically, the Act requires compliance with minimum standards of efficiency for new facilities and new sites; and calls for recommendations to the Governor and Legislature on possible changes in rate structures, advertising and other promotional activities which could result in more efficient use of electricity.

Finally, measures which would minimize wasteful, inefficient and unnecessary consumption of energy are to be included in environmental impact statements required for local projects under the California Environmental Policy Act.[8] This Act, similar to the National Environmental Policy Act,[9] requires environmental impact statements to be filed on significant actions affecting the environment.

The Act also charges the ERCDC with responsibility for developing and coordinating a research and development program [10] pertaining to energy supply, consumption, and conservation, in addition to facility siting R & D. The R & D program is to include such elements as the following: Development of methods for energy conservation required by the acts energy conservation program; energy facility design modification to insure greater efficiency; exploration and development of geothermal, solar and other alternative forms of energy; electrical facility design modification for increased protection from seismic activity; and improved methods for energy demand forecasting.

In order to anticipate future energy options and their impact, and to "influence Federal research and development priorities," the ERCDC is to carry out technical assessments on a variety of topics pertaining to nuclear energy, coastal and offshore siting of facilities, cooling, power transmission, efficiency improvement, transportation mode shifts, recycling, and utilization of waste heat.

Beginning in 1977, the ERCDC is to submit a biennial report [11] on overall energy needs, development, policies, and practices to the Governor and the Legislature. This comprehensive report, supported by extensive information and analysis by utilities, State and local

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[6] Power Plant Siting in California, op. cit., xiii.
[7] Cal. Pub. Res. Code §§ 25400–25405 (West Supp. 1975).
[8] Cal. Pub. Res. Code §§ 25400–25405 (West Supp. 1975).
[9] 42 U.S.C. §§ 4321 *et seq.* (1970).
[10] Cal. Pub. Res. Code §§ 25600–25601 (West Supp. 1975).
[11] Cal. Pub. Res. Code § 25309 (West Supp. 1975).

agencies and public hearings and comment is to provide a basis for State policy and actions relating to approval of new sites and facilities, their capacity and their potential capacity. Projections of overall siting needs, based on ERCDC demand forecasts, are to be made for a ten year period. A list is also to be made of possible sites to meet this ten year need, with characterization of kind and magnitude of the facility at each site.

A long range, 20 year projection of the likely environmental, economic and social impacts of continuing present trends must be made, and recommendations on demand reducing policies, energy conservation and development of potential energy sources are also to be made.

The planning and forecasting requirements of the act include these elements: [12]

Five-, Ten-, Twenty-Year Forecasts.—These forecasts, to be updated every two years, must be prepared by utilities according to a "common methodology" developed by the ERCDC. Alternative methodologies, if utilized, must be justified by the utility. The forecasts must state the basis for projections of greater demand; estimate savings that could be achieved through greater efficiency; specify alternative ways to meet increases in demand; indicate siting needs; and assess potential increases in capacity at existing sites.

Four Month Public Comment Period.—The forecast is to be forwarded to the Legislature, relevant State and Federal agencies, and local governments affected. It is to be available for public inspection in each county, and may be purchased at cost by the public. In addition, the State Public Utilities Commission is to submit an independent evaluation of the forecast to the ERCDC. Public comments and agency reviews may be submitted to the ERCDC during this four month period.

ERCDC Evaluation and Preliminary Report.—After evaluating comments by agencies, local governments and the public, the Commission is to issue a preliminary statewide report on the forecasts made by all utilities. This report, to be published six months after filing of the initial forecasts by the utilities, is to assess the accuracy and acceptability of the forecasts. It is to contain an assessment of the environmental, economic, safety and health impacts of the facilities proposed: alternative methods for achieving electricity demand; assessment of the demand projections; identification of required facilities on a statewide and service area basis; and an evaluation of measures by which demand growth for electricity could be reduced, and the possible effect of such reduced demand growth on critical environmental and other resources of the State. The report is to be made available for agency and public review.

Three months after distribution of the preliminary report, a public hearing is to be held in Sacramento. Within one year of filing of the forecasts, the ERCDC is to submit an overall analysis of the accuracy of the forecasts to the Legislature and the Governor as a part of the Commission's biennial report discussed above.

The Act gives the ERCDC exclusive authority to certify all sites and energy facilities in the State,[13] with the important exception of the permit area covered by the California Coastal Zone Conservation

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[12] Cal. Pub. Res. Code §§ 25300–25309 (West Supp. 1975).
[13] Cal. Pub. Res. Code §§ 25500–25542 (West. 1975).

Act.[14] In this instance, an additional permit must be applied for and received from the State coastal commission before construction can commence. In other cases, the certification process is *in lieu* of any other approval required by a State agency and supersedes any State or local law, ordinance or regulation.

The certification process involves the following major steps:

Notice of Intention of Filing an Application.—This preliminary application by the utility is designed primarily to assess the suitability of locating a facility on a proposed site. The utility must specify three alternative sites for location of the facility and at least one of the alternative sites may not be located in the coastal zone. After a public hearing in the counties affected, the Commission must issue a preliminary report on the notice. The report is to indicate the degree of conformity of each alternative site and facility with Commission forecasts, and with applicable State and local laws. Four months after distribution of the preliminary report for comment, the Commission is to publish a final report indicating conformity of the alternative sites and related facilities. After an additional public hearing on the report, the Commission is to rule on the preliminary notice. The notice may not normally be approved unless the Commission approves two of the alternative sites. In certain circumstances, the Commission may approve a notice with only one acceptable site, or, at the request of the applicant, designate an acceptable site from a State list.

Certification of Site and Facility.—This second stage in the project review process is to be initiated by an application at least 18 months prior to the planned construction date. The final application for certification is concerned with exact specifications, design and other factors. After a period of agency review, public comment and public hearings, the Commission is to issue a written decision on the application, specifying requirements for certification; degree of conformity with State and local laws and measures to maximize conformity; provisions for site restoration; and consistency of the project with the 10-year forecast. Projects which do not conform with State or local regulations may be approved only when there is no prudent or feasible alternative.

Of significance to land-use considerations, the act gives special attention to coastal areas, historic preservation districts and estuaries. Impact on such areas must be considered in projections of siting needs, and the regulatory process requires special caution when such areas would be affected. As already mentioned, sites may not be certified in areas under the regulatory authority of the California Coastal Zone Conservation Commission except with the prior approval of the coastal commission.

Parks, wilderness, and recreation areas, relatively undeveloped estuaries wildlife habitat and historic preservation districts may not be chosen for site certification unless the ERCDC finds that the facility would be consistent with the special values of the land area; that

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[14] Cal. Pub. Res. Code §§ 27000 (West. 1975). The California Coastal Zone Conservation Act was placed on the ballot of the 1972 general election by citizen initiative. It established seven regional coastal zone commissions, overseen by a state level coastal zone conservation commission. Charged with the responsibility of developing an overall coastal zone land use and water use plan for the consideration of the General Assembly 1976, the commissions were given interim powers to regulate essentially any major development proposed to be placed within 1,000 yards of the mean high tide mark during the planning period. The planning jurisdiction of the coastal commissions, however, is substantially larger.

there would not be a substantial adverse environmental impact, and that the public agency in charge of the land approves. The act also requires special consideration to be given to land under consideration for designation as a State or Federal wilderness, wildlife or game reserve.

In the event that a facility would be located in a coastal or scenic area, the utility would be required to purchase land for public recreation. Facilities proposed to be located close to a major water body would be required to be set back from the shore in order to permit public use, and to protect scenic and aesthetic values.

Moreover, the act authorizes the ERCDC to require utilities to purchase land adjacent to energy facility sites upon which increased population density might in the future be a threat to public health and safety. In the event that a local government already practices land use controls that would preclude such a population density, purchase would not be necessary. Any change in the existing local ordinance, however, would be reviewed by ERCDC to insure that the safe population density would not be exceeded.

The act authorizes the ERCDC to participate as a party in any application before a Federal agency, and is authorized to correspond, confer and cooperate with any Federal agency. Utility forecasts, and the ERCDC reports are also to be sent for possible comment by relevant Federal agencies. In the certification process, the notice of intent, the preliminary report, the report on notice of intent, and the application for certification must be submitted to relevant Federal agencies for review. In addition, the application for certification must specify the Federal agencies which must approve the application; the status of the Federal review; and the schedule for Federal completion of review.

MONTANA

Montana has substantial reserves of potentially strippable coal. As a consequence of the energy crisis and development of new energy technologies there are plans for construction of major energy production, conversion and transmission facilities in the State. For example, major expansion of strip mining in Montana could lead to construction of coal-gasification plants near the mine sites, with associated gas pipelines to transport the gas to distant markets.

In anticipation of an energy boom, Montana enacted three laws in 1973 which were designed to reduce the impacts of such development, including a strip-mining law, and a resource indemnity trust act, which established a tax on the mine-mouth or wellhead value of nonrenewable resources in order to assist Montana's communities in coping with adverse environmental, economic and social impacts of energy resource development.

In the same year, the Montana legislature enacted the Utility Siting Act.[15] Unlike most State siting acts, which apply only to powerplants and transmission lines, the Montana act also applies to gasification and liquefaction plants, pipelines related to these facilities, and geothermal energy facilities, in addition to major powerplants and electrical transmission lines.

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[15] Mont. Rev. Codes Ann. §§ 70–801 to 70–823 (Supp. 1974).

The act is administered by the Department of Natural Resources and Conservation, and the Board of Natural Resources and Conservation. The Board, a seven member body appointed by the Governor, is the decisionmaking body for certification of new facilities, and approval of long range plans. The Department coordinates review of energy facility proposals by other agencies, evaluates projects and plans, and does most of the staff work pertaining to the act.

The act is financed through a tax levied on energy industries. A separate fee to cover the cost of reviewing applications for certification of projects is charged.

The act requires each utility to submit an annually updated ten year plan to the Department of Natural Resources. The plan is to specify the anticipated location, size and type of facilities to be constructed during the time period; coordination efforts with other utilities to meet regional energy needs; and is to contain a description of efforts to involve environmental and land use planning agencies in the plan development, as well as efforts to identify and minimize environmental problems at the earliest possible stage in the planning process. The plan is also to include projections of demand for the service, the basis for such projections, and the extent to which the proposed facilities will meet those projections. Each utility's long range plan is to be available for public inspection, and is also to be filed with appropriate State agencies.

For its part, the Department of Natural Resources and Conservation must conduct a preliminary evaluation of facilities which the utility expects to construct within the next five years. Information gathered from this evaluation may be used in the certification proceedings. There is no advanced certification of these sites however.

Evaluation of long term plans, five year site reviews, and certification is to be guided by a number of statutory criteria stated in the act. These criteria, too numerous to be cited, pertain to energy needs, land use impacts, and water resource, air quality, solid waste, radiation, and noise impacts, in addition to monitoring.

The act establishes a certification process for major energy facilities, financed by an application fee based on the estimated size of the proposed project. Since the evaluation of the application is detailed, the filing fee may be substantial: in one instance, the fee amounted to $1.2 million.[16] An application for certification must be filed at least two years before construction of the facility, with the exception of transmission lines, for which application only needs to be filed nine months prior to construction.

The application must include a description of the proposed site and facility; a summary of environmental impact studies; a statement of need for the facility; a description of possible alternative locations for the facility, and a statement of the reasons why the proposed site was chosen. Proof of service of the application to the local governments involved, including localities that would be affected by the alternative sites, and to the state agencies with environmental and land use planning responsibilities in the area must be provided to the Department. The application must also be available for public inspection.

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[15] See William Christiansen, The Energy Crunch, State Government, Autumn, 1974, p. 207. This application fee was for a 1,400 MW power facility with 450 miles of related transmission lines.

Upon receipt of the application, the Department of Natural Resources and Conservation is to conduct a six month study on the proposed project. In addition, the Departments of Health and Environmental Science, Highways, Intergovernmental Relations, Fish and Game and Public Services are also to assess the project in terms of their own expertise.

The studies are to be forwarded to the Board of Natural Resources and Conservation, which is to hold a certification proceeding within two months of their receipt. Parties to the certification include the applicant, each municipality involved, any resident of such a municipality, non-profit organizations representing environmental health, historic preservation, consumer or commercial or industrial groups, and the Department of Natural Resources and Conservation.

The Board may either approve, conditionally approve or deny the application. If the board certifies the project, with or without modification, it must state in writing the basis for the need of the project; its probable environmental impact; the measures taken to reduce environmental impacts, given the economic feasibility of existing technology; and the conformity of the project with applicable State and local laws. However, the Board is specifically authorized to refuse to apply a local law or regulation it deems unreasonably restrictive.

The Board must find that the proposed facility will not violate State or Federal air and water quality standards and implementation plans. The judgment of State and Federal air and water quality agencies are to be considered conclusive in this matter.

Except for this deferral in judgment to the State air and water quality agency, no other State or local agency may require a consent or other approval for construction, operation or maintenance of a facility defined in the act.

MARYLAND

Maryland's Power Plant Siting and Research Act [17] was originally passed in 1971, but it was amended in 1974. It differs from most State power plant legislation because it authorizes advanced State acquisition of sites for new facilities, and establishes an environmental trust fund, based on a surcharge on electricity generation, to establish a research program to minimize the impacts of powerplants.

The law is administered primarily by the Department of Natural Resources (DRN), which is authorized to classify sites proposed in a utility's ten year plan as suitable or unsuitable, administer the environmental trust fund and the power plant environmental research program, and is responsible for acquiring a state inventory of potential sites. The state Public Service Commission, which is responsible for issuing certificates of public convenience and necessity, and the state Department of Health and Mental Hygiene and Economic and Community Development also have responsibilities under the act.

The act requires the utilities of the state to prepare on an annual basis, and the Public Service Commission to compile and evaluate, ten year plans specifying proposed and potential sites for new facilities, including related transmission lines.

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[17] Md. Nat. Res. Code §§ 3–301 to 3–307 (1974).

The Department of Natural Resources must conduct a preliminary environmental assessment of sites proposed in the ten year plan of the utility within six months of transmittal of the plan from the Public Service Commission.

The environmental impact statement is to specify adverse environmental effects, possible alternative sites, irreversible or irretrievable commitment of resources if the site is chosen, and a plan for monitoring the environmental effects of the project if approved, with provisions for remedial action.

If the Department determines on the basis of this evaluation that a proposed site is unsuitable, the Public Service Commission must delete it from the ten year plan. The utility is given the opportunity to contest the deletion of a site, by offering substantial contrary evidence to the Department of Natural Resources. A 1972 opinion by the State Attorney General indicated that a site which would result in a violation of Federal or state environmental standards must be declared unsuitable.

If the preliminary evaluation suggests that the site is suitable, the DNR is to conduct a comprehensive evaluation of the site. A final environmental impact statement on the site is to be published at least two years prior to the proposed date of construction. If the preponderance of evidence suggests that the preliminary determination of suitability was faulty, the DNR may request the Public Service Commission to delete the site from the ten year plan.

Under the Maryland law, actual certification of a proposed facility is made by the Public Service Commission, not the DNR. The DNR's responsibility rests primarily in the site evaluation. However, the DNR is a party to the hearing on certification.

The act establishes an environmental trust fund for the purpose of minimizing environmental impacts of new energy facilities. This fund was initially financed by a surcharge on electricity consumption throughout the state, but was modified in 1974 to a surcharge on electricity generated so that out of state customers would indirectly contribute to the fund through the surtax by the utility. Money from the fund is to be used for a continuing research program for evaluation of powerplant siting and related environmental and land use factors.

The fund can be used for reimbursement of utilities for environmental research necessary to meet state, local and federal requirements, and also to finance independent state evaluation of proposed projects. Such evaluations may cost $500,000 to $1,000,000.

The act also authorizes the state itself to acquire plant sites, either through condemnation or agreement. The cost of acquisition may be paid for by the environment trust fund.

The rationale behind the acquisition program is to have a sufficient supply of suitable sites available for energy facilities if a site proposed by a utility is deemed unsuitable, but the facility itself is considered necessary within the time period planned by the utility. In the event that the utility buys or rents such a site from the State, local zoning or other regulations are not applicable to the site. The State inventory of acquired sites is to consist of four to eight sites at any given time.

MINNESOTA

Minnesota's 1973 Powerplant Siting Act[18] requires the State to develop an inventory of tentatively suitable sites for powerplants and corridors for transmission lines. This inventory is to form the basis for designation of future sites for powerplants and transmission lines. If a utility chooses a site that is not on the State inventory, the site must be consistent with the criteria and standards employed in developing the inventory. In most other State powerplant siting acts, the State evaluates sites proposed by a utility, but does not require preidentification of potentially acceptable sites. The Minnesota approach theoretically gives the State much greater control over the location of new facilities since it substantially limits potentially available sites; it may also give the State some control over timing of new facilities in a given area since sites can be selectively added or substracted from the inventory. Finally, it may maximize the opportunity for integration of energy facility planning with other kinds of planning.

The act is administered by the State Environmental Quality Council, composed of five directors of State agencies with major environmental responsibilities or impacts, and four members of the citizen's advisory committee on environmental quality. This advisory committee, representative of all congressional districts in the State, is a gubernatorially appointed and State Senate approved body designed to be a "vehicle for citizen participation in the activities of the council.[19]

The multidepartmental representation of the Environmental Quality Council grew out of a recognition that environmental problems encompassed the responsibilities of several agencies. In addition to its powerplant siting responsibilities, the legislature gave the council the authority to coordinate interdepartmental administration of programs that impact the environment, and to resolve conflicts between agencies in a manner consistent with State environmental policy.

Pursuant to the Powerplant Siting Act, the Environmental Quality Council (EQC) is to establish a "public planning process" to develop criteria and standards for conducting an inventory of potential facility sites and transmission line corridors on a statewide basis. The inventory itself is a map of potentially acceptable sites and transmission corridors which utilities may use in planning new facilities. The inventory is to be evaluated, revised and published on a continuous basis.

Utilities planning construction of a new facility within a 5-year period must submit a plan specifying the general size and type of facility, and the location of the utility's preferred site for the facility plus one alternative site. The sites may either be included in the inventory, or may be a site of the utility's own choosing—in which case the utility must state its reasons for selecting this site in lieu of a site on the State inventory, and must evaluate the site in terms of the EQC site inventory criteria.

After publication of the State inventory and submission of the utilities 5-year plan, the utility may apply to the EQC for designation of a specific site or corridor for a specific size and type of facility.

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[18] Minn. Stat. Ann. §§ 1160.51–116C.69 (Supp. 1974).
[19] Ibid.

The time for the EQC ruling on the application is 1 year for designations of a site and 6 months for designation of a transmission line, but the time period may be extended an additional 6 months.

The act lists ten statutory criteria which the EQC is to consider in designation process:

> (1) Evaluation of research and investigations relating to the effects on land, water and air resources of large electric power generating plants and high voltage transmission line corridors and routes and the effects of water and air discharges from such plants on public health and welfare, vegetation, animals, materials and aesthetic values, including base line studies, predictive modeling, and monitoring of the water and air mass at proposed sites and sites of operating large electric power generating plants, evaluation of new or improved methods for minimizing adverse impacts of water and air discharges and other matters pertaining to the effects of powerplants on the water and air environment;
>
> (2) Environmental evaluation of large electric power generating plant sites and high voltage transmission line corridors and routes proposed for future development and expansion and their relationship to the land, water, air and human resources of the State;
>
> (3) Evaluation of the effects of new electric power generation and transmission technologies and systems related to powerplants designed to minimize adverse environmental effects;
>
> (4) Evaluation of the potential for beneficial uses of waste energy from proposed large electric power generating plants;
>
> (5) Analysis of the direct and indirect economic impact of proposed large electric power generating plants and high voltage transmission lines;
>
> (6) Evaluation of adverse direct and indirect environmental effects which cannot be avoided should the proposed site and transmission line corridor or route be accepted;
>
> (7) Evaluation of alternatives to the proposed site and transmission line corridors and routes;
>
> (8) Evaluation of irreversible and irretrievable commitments of resources should the proposed site and transmission line corridor or route be approved;
>
> (9) Where appropriate, considerations of problems raised by other State and Federal agencies and local entities;
>
> (10) Where rules and regulations of the council as set forth—are substantially similar to existing rules and regulations of a Federal agency to which the utility in the State is subject, the Federal rules and regulations shall be applied by the council.[20]

If the Council approves a site or corridor, it is to issue a certificate of environmental compatibility.

The certificate of environmental compatibility supersedes any local requirements for site approval. No certificate of site compatibility may be issued, however, that would violate State agency regulations. Utilities must apply for permits required by other State agencies pertaining to the construction and operation of a facility, but the EQC decision pertaining to site approval is binding upon the other agencies.

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[20] Minn. Stat. Ann. § § 116C.51–116C.69 (Supp. 1974).

The Minnesota law requires the council to adopt "broad spectrum public participation as a principle of operation." While the act requires advisory committees to be established and public hearings to be held, it indicates that public participation shall not be limited to these two devices. As a part of its rulemaking authority, the EQC is required to establish "minimum guidelines for public participation in the development, revision and evaluation and enforcement of any regulation, plan or program established by the council." All meetings and hearings of the council are to be open to the public, and the records and correspondence of the council are to be available for public inspection.

CHAPTER IV.—LAND AND ENERGY CONSIDERATIONS IN FEDERAL AGENCY PROGRAMS*

Introduction

Perceptions of the need to integrate land use and energy considerations are beginning to emerge to some degree in those agencies and departments of the Federal Government which deal with either land or energy, or both. As an official of the U.S. Geological Survey put it, "It's hard to do anything in energy without impacting the hell out of land use." And a Federal Energy Administration planner said in an interview, "There's nothing you can do in energy that doesn't impact heavily in other areas—there's better and there's worse impacts. And we're after the better."

While there is near universal recognition in the Federal agencies contacted for this report of the close interrelationship between energy programs and land use, the actual responses among these agencies are various. This chapter is an attempt to list the Federal programs and activities which integrate land use and energy considerations. The information presented here was gathered from Federal agencies and departments which, by their mission, would normally deal with the interactions of land and energy. This compilation is based on both written documentation and personal interviews with agency staff members.

The findings are set forth on an agency-by-agency basis, making interagency comparisons awkward. A more important constraint on comprehensive analysis is that most of the agency programs are of quite recent vintage. In fact, many of the research programs reported here are still underway, with completion dates ranging from 1976 to 3 years hence.

Furthermore, only a few of the studies reported here deal with land and energy interrelationships as their central focus.

Despite these caveats, there are some general observations that may be made. For example, among officials interviewed there was a pervasive feeling of unease over the extent to which land-and-energy considerations would ultimately be woven into overall agency programs and policies. The FEA spokesman complained that whereas there was functional planning for transportation, housing, and other aspects of the physical infrastructure, functional energy planning had been absent in comprehensive planning at the State, regional, and local level. In his view, this was upsetting since, "coordination of functional planning *is* land-use planning, and the energy component has been lacking." Though many planners might argue with this definition of how comprehensive planning works, it is nevertheless true that only

*This chapter was prepared by Susan R. Abbasi, Analyst in Environment and Natural Resources Policy, Congressional Research Service.

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a few States (notably California and Minnesota) and localities have woven energy considerations into the comprehensive planning fabric.

Evidencing a slightly different perspective, a member of the land use staff of the Council on Environmental Quality felt that though a large number of studies and research efforts were devoted to energy production, very little was being done on the impacts to the community. With this, the FEA planner agreed "No one in the Federal Government has leadership in a well defined way for this," he commented.

Both the lack of leadership and the pervasiveness of land use and energy concerns is emphasized by the large number of interagency efforts among the Federal programs which attempt to integrate the two issues. In fact, the most meaningful of the integrative projects are, insofar as their meaningfulness can be predicted at this time, interagency efforts. As one FEA study has stated, to discuss land use activities and energy activities together is to discuss virtually the entire range of human activities.

There is a third concern which may be adduced from the interviews. Some are concerned that even though many research projects are interagency efforts and even though they may reveal significant new ways to handle the essential conflict between land use and energy development, that in the end such integrative efforts will lack clout. Most of the officials interviewed were, generally speaking, not enthusiastic over the degree to which land-use/energy considerations were being taking into the account in the actual decisionmaking process. Thus, although the amount of research is increasing, there is no definite indication yet that increasing attention will be paid to land and energy interactions at the level of policy determination. The relatively low level of priority given to these efforts was revealed by general dissatisfaction expressed by agency officials over the low level of staffing for land-and-energy planning. Commented the FEA planner, "there is essentially no planning function in FEA per se" related to land use. "We are overwhelmed—we really can't handle it," he said, referring to his office's workload in the land use/energy area.

Similarly, an Environmental Protection Agency spokesman expressed dismay over the effect of the day-to-day pressures on the need to conduct coordinated research with other agencies. Complaining that it was difficult for the EPA staff to get the attention of the counterpart staff at the Energy Research and Development Administration to cooperate in an up-coming energy facility siting conference, he had to admit, "They're as overworked as we are—there isn't time to do the work in your own agency and attend all the interagency meetings, too."

Another characteristic of the issues in the land/energy interaction is that Government agencies dealing with land use and energy have little opportunity to deal forthrightly with *national* policy. Therefore, most of the land use-energy programs are directed outward, to be utilized by States and localities. This is particularly true of those studies, reports, and computer models whose purpose is to predict on-the-ground land use and energy interactions. The logic in this technical assistance approach is that use decisions per force dictate many energy consequences, and land use policy is still almost entirely within the

domain of State and local governments. Computer modelling by the FEA and ERDA, and handbooks developed by the Department of Housing and Urban Development and by the National Science Foundation, described in this chapter, are all designed to provide guidance to local governments on coordinating land use and energy planning.

Following from the present locus of land use policy within State and local jurisdictions is a further generalization which can be made about the programs reported here. It appears that the programs which most successfully focus on the *interconnection* of land and energy are most often those of agencies whose mandate has to do with energy, rather than those which have had to do with land use. This is in part due to the fact that the Federal Government's role in energy matters is more substantial than its limited role in land use concerns. The Department of Housing and Urban Development and the Department of Transportation both have programs which profoundly influence land uses or involve the direct use of land, and which in turn can have an important effect on policies dealing with energy use and development. Yet these agencies have been somewhat slower to integrate land and energy considerations than have the new energy agencies such as the Energy Research and Development Administration, the Nuclear Regulatory Commission, and the Federal Energy Adinistration. This difference is perhaps attributable to the probability that a new agency has a better chance to introduce new kinds of programs, unimpeded by the preoccupation with ongoing programs that an established agency may have. Nevertheless, the fact remains that to the extent that there is leadership in integrating energy and land use concerns, it tends to be exercised by those agencies whose mandate has to do with energy policy rather than by those more traditionally connected with land use.

This phenomenon is one which should be kept in mind as the program descriptions are read. To the extent that the leadership in determining the policy interconnections between land use and energy comes from energy agencies, it may be well to ask whether their programs are, or are likely to be, truly integrative. It is quite possible, and understandable, that land use considerations would be seen as a subset of energy policy objectives by an agency whose primary purpose is to implement energy policy.

Another important question is whether the studies and programs described here will find their way into policy considerations and higher-level decisionmaking. The manpower problems described by agency staff members, the fragmented leadership, and the possible lack of influence of programs which make a sincere effort at policy integration of land use and energy concerns may only produce documents that gather dust on the shelves, or planning and technical services that are unused.

The most fundamental question to be kept in mind, from the perspective of this report, is whether or not the programs described are conceived and designed in a way that will facilitate a national policy synthesis for land and energy. The very number of these integrative programs suggest an issue recognized by virtually all the agencies studied. And while it is often beyond their mandates to integrate policy at the national level between land use and energy, their current activities may yet provide insights needed for this process.

Energy Research and Development Administration (ERDA)

The Energy Research and Development Administration has a relatively new and very broad mandate to carry out research and development programs on a wide range of energy production systems and technologies. The land use ramifications of the energy systems being explored and developed by ERDA are significant. However, the land use consequences of the ERDA programs are not a central focus of their research, since it is centered on the technologies themselves. Even though these consequences are being looked at directly in one of the ERDA administrations, whose programs are discussed below, it is unclear to what extent land use considerations are in fact being integrated into ERDA's over-all decision-making process on priorities for energy system development.

The ERDA was established by the Energy Reorganization Act of 1974. However, it is not, strictly speaking a new organizational entity, because it inherited the facilities and programs of the Atomic Energy Commission, which was abolished by the act. Only the licensing and regulatory functions of AEC were transferred elsewhere, located now in the Nuclear Regulatory Commission, also established by the act. In addition to the nuclear energy power generation and weapons research programs of the AEC, the new ERDA was also given the responsibility for research and development programs on nonnuclear energy development in all forms.

There are six program administrations in ERDA: Fossil Energy; Nuclear Energy; Solar, Geothermal and Advanced Energy Systems; Environment and Safety; Conservation; and National Security (weapons and safeguards). Although all six ERDA administrations have land use implications, it is in the Environment and Safety Administration that land use is most directly taken into consideration.

This Administration inherited programs on ecology and land use modeling that had been initiated under the Atomic Energy Commission. In addition, it is generally responsible for environmental effects of ERDA programs, and thus has a broad mandate which could certainly include future land use studies, as well.

Under the Administration's Division of Biomedical and Environmental Research, the Regional Studies Project involves land use/energy computer modeling programs at the national laboratories at Los Alamos, Livermore, Argonne, Brookhaven, and Oak Ridge. The program at Oak Ridge National Laboratory began about 5 years ago under the AEC and is said by ERDA spokesmen to have the most fully developed land use model. It is being used as a basis for the regional models at the other labs. The applications are for regional systems analysis, and so the data base differs from one laboratory to another.

Much of the input data come from other agencies: ERTS satellite data are used, as are Geological Survey data on coal, minerals, water, and topographic data; the Bureau of the Census contributes data on distribution of population; the Agriculture Department is the source of information on ground cover; and the Bureau of Business Economics is a contributor of socio-economic data.

The Oak Ridge program is geared toward the Appalachian region, and is designed to provide specific analysis of particular problems, such as strip mining in a particular area. Other laboratories utilize

applications of computer systems which emphasize different areas of concern. At Livermore, for example, there is an emphasis on geothermal energy effects: ERDA is working on putting in place a $2 million baseline information program on geothermal/land use concerns, for evaluating such problems as subsidences, saline water disposal, and health impacts connected with geothermal energy development in the Imperial Valley.

At Argonne National Laboratory, reclamation of strip-mined areas is the major emphasis. Moreover, Great Lakes water use data for the region including North Dakota, South Dakota, Wyoming and Montana are also available there.

At Brookhaven, the emphasis is on health and on urban impacts. The Reference Energy System at Brookhaven has been used in studies for the Federal Energy Administration and other contract studies, and is designed to give energy consequences of various land use planning decisions. (Under the discussion of the Federal Energy Administration one application of the Brookhaven system is described in more detail.)

The Environment and Safety Administration also has underway a 10-volume study providing an analysis of each of the technologies in ERDA's programs from resource recovery to end use, with assessments of environmental and health impacts, including land impact information.

Another effort related to land use in the Biomedical and Environmental Research Division is the "environmental research parks." The AEC acquired large chunks of land in its early days in order to have available buffer zones around potential nuclear installations. Although some half of these lands have been disposed of to local governments or for other public uses, ERDA now possesses lands located in most major ecosystem types in the U.S., with parcels averaging 2,000 acres each. The "parks" have been used as environmental research areas over the years, sometimes to trace radionucleides through ecosystems, sometimes for purposes unrelated to the AEC programs. Results of studies in these areas have been made available to the AEC, but not always used by them. Some of these areas are now being proposed for official designation for these purposes.

Federal Energy Administration (FEA)

Since its creation in December of 1973, the Federal Energy Administration has occupied a central role in the roster of Federal energy agencies. Established first by Executive order as the Federal Energy Office, and given statutory authority as an independent agency in May of 1974, its initial focus was on meeting the severe energy shortage problems of 1973 and the following months. It was designed primarily to deal with energy demand and supply problems through possible rationing and allocation plans and related programs. Included in the agency's functions are a number of planning and evaluation activities. It is through these planning, research, and evaluation functions that FEA deals directly with land use and energy relationships. There are six administrations within FEA: Policy and Analysis; Regulatory Programs; Management and Administration; International Energy

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Affairs; Conservation and Environment; and Energy Resource Development.

Insofar as it is clear that all energy activities will have some impact on land use, it is obvious that all of the six FEA administrations will have land use consequences to some degree involved in their activities. However, it is in the Energy Resources Development Administration and the Conservation and Environment Administration that land use factors are most directly taken into account.

In the Conservation and Environment Administration, for example, the Office of Analysis, Evaluation, and Systems Studies has contracted for several studies which directly involve land use considerations. The emphasis in this office is on the conservation of energy, and how this can be achieved through land use planning and better information sources.

One study is a comprehensive analysis of the interactions between land use and energy utilization. Entitled, "An Overview and Critical Evaluation of the Relationship Between Land Use and Energy Conservation," the report includes historical evolution of these relationships, the legal and governmental framework which shapes land use/energy interactions, and other factors. It includes a discussion of the Federal, State and local programs which deal with energy conservation and land use. The objective of the study is to assist in the identification of energy research priorities.

Another study, for which an interim report was issued in October, 1975, is titled "Land Use and Energy Utilization," contracted by the Brookhaven National Laboratory and State University of New York. Based on the Brookhaven Reference Energy System, the contract is for development of a land use/energy/environment model, designed for use by local planners. Using Nassau and Suffolk counties for its initial application, the model is for a computerized system through which planners could get an evaluation of the gross energy impacts of a given planning concept. For example, the planner could specify an area such as low density housing, and get back the consequences of this use of land for transportation, jobs, commercial areas. and other needs, including the associated energy demands.

In two separate studies, specific issues related to energy conservation as it can be achieved through land use are being examined. These issues include energy conservation in new communities—how best to plan for conservation, and what kinds of planning are underway now to achieve it; how land use policy is promulgated at all governmental levels and how FEA could interject energy planning into land use issues; the consequences of regional energy optimization (if energy utilization is optimized on a regional basis, what happens on the national level to land uses, energy conservation, and other effects); impacts of new technologies such as solar and others on land; and social impacts—if energy usage is minimized through conservation, especially land use techniques, what are the social consequences?

Through the Office of Analysis, Evaluation, and Systems Studies, the FEA is also participating in the interagency follow-up effort on *The Costs of Sprawl* report, issued in 1974 by the Council on Environmental Quality in cooperation with EPA and HUD. This report

deals with economic considerations; the new FEA component is to show how metropolitan governments can identify *energy* costs involved in various forms of development.

Another part of the Conservation and Environment Administration, the industrial group, is involved in questions of facility siting and the feasibility of energy parks; an environmental regulations group is examining the problems of "boom towns" associated with energy development.

In the Energy Resources Development Administration, the other major part of FEA dealing with land use, resources planners in the Office of Facility Development and Siting are involved in providing information and assistance to companies and Government officials in understanding Government procedures and requirements, and to help local and State governments recognize energy problems. In several areas, this involves land use considerations as they are connected to energy facility development. The Facility Development and Siting Office has completed, through its ad hoc energy facilities task force, a comprehensive inventory of future powerplants, based on earlier research on the Federal Power Commission. The FEA inventory is designed to provide "a common facility inventory data base to monitor the changes which have and will occur with time. . . ." Although land use and environmental factors were not included in the inventory, the listing can serve as a guide to the locations where future plants are to be located.

The Facility Development and Siting Office also is the screening unit in FEA for Federal surplus property evaluations; its function is to determine whether surplus property which is available for disposal would be useful as an energy facility site. FEA does not assume any custody of the property, but merely makes a recommendation to the General Services Administration, which is the agency that carries out the disposal. Whether a site is eligible for energy use comes into question according to a planner in the office, when "some [utility or energy] company is interested in it."

When this is the case, criteria such as whether water supply is adequate, whether air quality standards would be a problem, and others, are applied by FEA, and a recommendation is made.

The office is also involved, as staff to the Energy Resources Council, in providing background information for mineral leasing questions. FEA, as staff to the ERC, provides the demand assessment for policy deliberations on the need to lease lands in the West for coal, and on the Outer Continental Shelf for oil.

Another function involved in this office's role in expediting energy development is related to ameliorating secondary impacts of energy development. In this connection, FEA funded an Arizona study entitled the "Energy, Environment and Growth Plan." The office is also technical liaison with planning and efforts under the Coastal Zone Management Act. Instructions are given to the regional offices in coastal states on how to integrate considerations of energy needs into state coastal planning. There is a possibility that FEA may begin participating as intervenors in site-specific issues, and they have worked specifically on expediting energy facility development, such as the Pittston refinery in Maine.

FEA and the Department of Housing and Urban Development recently signed a memorandum of agreement that HUD will encourage the inclusion of energy factors in its "701" area-wide planning programs. In some cases, energy plans for areas can be done with grants from the 701 program.

The Energy Resource Development Administration was primarily responsible for the "Project Independence" report, which detailed the consequences of several alternative future energy supply scenarios. Land use consequences were directly discussed in only a small portion of that report. Since then, a greater effort has been made to integrate land-use considerations in updating the report, although the emphasis, naturally enough, is on energy development and conservation as the controlling factor.

Federal Power Commmission (FPC)

The FPC is an independent regulatory agency functioning primarily as regulator of interstate natural gas rates. It also licenses non-Federal hydroelectric power generating facilities, keeps an inventory of hydroelectric facilities, regulates various aspects of rates charged by electric power utilities, and maintains the National Power Survey and the National Gas Survey which analyze the related issues, alternatives, and availability of electric power generation and all phases of natural gas production.

FPC licensing of hydroelectric facilities entails direct land-use decisions in connection with energy production. In its other activities, however, land use considerations are not factors in the decisionmaking process, although rate determinations which affect distribution of electric power and natural gas can have significant land use consequences.

The Power Survey and the Gas Survey are both important working documents in the assessment of energy needs and production capacity, but these also do not contain land use components to any significant degree.

Thus the FPC, although an important energy agency in the Federal Government, is directly concerned in energy activities which may have land use effects, but it is not among the agencies focusing on the interrelationships directly.

Nuclear Regulatory Commission (NRC)

The Nuclear Regulatory Commission (NRC) was established in October 1974, by the Energy Reorganization Act. The Atomic Energy Commission was abolished in that act and the NRC inherited the former AEC's responsibilities for licensing and providing permit approval for nuclear power generating facilities.

Obviously, the decision to build a nuclear power plant is an important land use decision, since it affects future land uses in the adjacent areas, and has many secondary development effects as well. Nevertheless, in the NRC, the major focus is currently confined to plant safety. According to NRC spokesmen, land use considerations are mostly left to the State and local officials in the area of the proposed plant. The NRC considers land questions in the permit approval process only

insofar as there might be questions of safety or feasibility connected to them, such as earthquake hazard, or water availability.

However, section 207 of the Energy Reorganization Act of 1974 gave the NRC a direct land use mandate—to conduct a Nuclear Energy Center Site Survey, with a report to Congress by October of 1975 on the location and identification of possible sites for nuclear energy centers, together with conclusions on the feasibility and practicality of the concept itself. Such centers are locations where several nuclear generating stations may be grouped, combined in some cases with fuel conversion facilities and waste disposal capacity.

The report was delayed until January 1976. Its recommendations of feasibility have significant land use implications. According to an NRC summary of the reports' contents, the site survey contains criteria for the selection of suitable locations for such facilities, and identifies and tabulates Federal land, and other areas of sufficient size, suitable for siting nuclear energy centers. Criteria and the methodology were developed for exclusion of land areas not suited for siting nuclear energy centers because of population, geologic, seismic, atmospheric, flooding or other considerations, including landuse and legal constraints. Criteria for appropriate sites include land requirements, electric power demand data, transmission projections, heat dissipation capacity of areas, and water availability.

This survey represents an important land use/energy function of the NRC, and undoubtedly will be a working tool in the land use/energy policy area.

Environmental Protection Agency (EPA)

The Environmental Protection Agency, as the independent regulatory agency charged with enforcing a wide range of pollution control laws, is a focal point in the environmental/energy confrontation which has developed in the past few years. In addition to its pollution control enforcement responsibilities, the EPA also carries out research and development on a wide range of pollution abatement techniques and strategies. In both the enforcement and research functions in EPA, land use factors are important, since regulation of pollution can involve land use strategies for pollution abatement. Moreover, EPA studies the effects of pollution from the point of view of their land use consequences.

The EPA is a participant in a number of interagency land use studies and energy studies, and is directly involved in a number of ways in the energy/land use interrelationships.

In the office of the Assistant Administrator for Research and Development, the Office of Energy, Minerals and Industry deals most directly with the energy/land use issues. Additionally, the Office of Air, Land and Water Use has some overall planning functions which deal secondarily with energy impacts.

The Energy, Minerals, and Industry Office is charged with assessment of the socioeconomic impacts of energy and mineral resource extraction, processing, conversion, and utilization systems. It is also directed to develop and demonstrate methods of control and management of the environmental impacts of such operations, and the identifi-

cation and evaluation of alternatives. These responsibilities have resulted in various studies being contracted by this office, addressing energy development and its land use and environmental impacts.

The Office has an overall "Integrated Assessment Program" which is designed to examine energy-related issues that cut across the air, land, and water environmental boundaries.

Among the studies underway in this program is "A Technology Assessment of Western Energy Resource Development" which is designed to detail the impacts in the West of all types and all phases of energy development. This would include coal, oil shale, geothermal, solar, and other types of energy resources, and would cover mining (both underground and strip mining), transmission, and conversion facilities. The study, begun early in 1975, is likely to take 3 years. Environmental effects will be the major focus of the study; a section on land use effects will include secondary impacts such as the support facilities, boomtowns, and other growth associated with energy development. A separate assessment is also underway on the electric utility industry, again focusing on environmental effects and including land use considerations.

Another effort of the Energy, Minerals and Industry Office is the cosponsorship of a conference on energy facility siting, along with the Energy Research and Development Administration. This is one of an annual series of conferences at Batelle Institute in which current issues in energy and environment are discussed with participants from government, academia and public-interest organizations and industry. The major goal of this conference is to improve data utilization, and to gain a better understanding of the data needed for proper energy siting in order to avoid adverse environmental effects. An associated effort is an assessment of surface mining reclamation techniques with the objective of identifying methods to effect full restoration. Part of this assessment involves premining planning techniques to minimize environmental damage.

Another study, with a regional forum, deals with the effects of energy development in the Lower Ohio Valley, including land use consequences of energy activities.

The Office of Air, Land, and Water Use has more general land-use and research planning functions. A reorganization of the Administration, however, has specifically excluded from this office's functions studies of the management of pollutant discharges or waste disposal that are related to energy, mineral, or industrial processes. Nevertheless, the office does undertake studies related to metropolitan transportation planning. These activities involve some land use planning designed to reduce auto traffic for the purpose of reducing emissions of air pollutants, which involve the concomitant effect of reducing fuel usage as well.

Under the Assistant Administratior for Air and Waste, the interrelationships among air quality regulations, energy activities and land use are dealt with directly. This office deals with the regulations to prevent significant deterioration of air quality. In cooperation with FET, the office contracted a study titled "An Analysis of the Impact on the Electric Utility Industry of Alternative Approaches to Significant Deterioration," which was completed in October 1975. The present

regulations on significant deterioration of air quality involve three classifications of areas in which powerplants are planned: those in which no deterioration would be permitted, those in which minimal deterioration would be permitted and where new facilities could be located but with the most stringent pollution control devices available, and the third classification in which deterioration of air quality to the level of national standards would be permitted. In the implementation of these standards, the siting of powerplants and other energy facilities could be affected; the study of the electric utilities' air impacts considered the effects of mandatory classification I for sensitive areas and the effects of class II designation on location of power plants now scheduled to go on line between now and 1985. With the inclusion of best available technology, it was concluded that very few of the utilities looked at would be significantly affected.

In other air quality regulation, the air quality maintenance requirements proposed by EPA include the necessity for an air quality maintenance plan in areas where standards for ambient air quality cannot be met by the statutory deadlines. There is a land use component in these plans, aiming to reduce reliance on automobile transportation, with consequent reduction in fuel utilization, as well.

Another issue relating to air quality is the mandatory conversion to coal required under the Energy Supply and Conservation Act. In this process, the FEA determines which power generating facilities should be required to convert to coal utilization by prohibiting them from using oil or natural gas, and EPA examined these orders to determine whether such conversion would cause violations of air quality regulations. Conversion to coal has some secondary land use impacts including increased demand for coal-bearing land, and the problems of waste disposal of resulting ash discharges.

In EPA there is also an overall Office of Land Use Coordination in the Administrator's Office. Its mission is to track and coordinate the functions of EPA that have land-use consequences. However, this office has not been much involved in energy-related programs except insofar as it may become involved in the energy and land use questions that the other offices described here are dealing with.

National Science Foundation (NSF)

The NSF is charged with directing the capabilities and knowledge of the scientific community into development of useful knowledge and technology applied to the needs of society. An independent agency, established in the National Science Foundation Act of 1950, it has authority to fund research in many areas of concern. It awards grants, contracts, and enters into cooperative agreements with universities, nonprofit and other research organizations.

As a result of the energy crisis which developed in the early 1970's, the number of NSF-funded studies and reports on energy problems greatly increased. However, with the establishment of the Energy Research and Development Administration (ERDA), NSF is relinquishing some of the energy subject areas in which it had been active.

There are several offices in NSF which are concerned with energy or land use; however, spokesmen for these offices generally felt that

the interconnection between the two was not the direct focus of attention in their studies, with just a few exceptions.

The Office of Energy Research and Development Policy provides direct staff support in the energy area to the Director of NSF in his role as Presidential Science Adviser. The office does not fund research, but is concerned with policy analysis. Almost any area of energy technology and energy needs in relation to scientific capability and research potential could be the subject of this office.

In the Research Applied to National Needs (RANN) program there are three divisions of relevance to energy or land use: the land use and growth program, the Energy Division, and the Environmental Division.

Environmental effects of energy development of various types have been the subject of the Environment Division studies, but a spokesman indicated land use effects had not been directly considered; in the Energy Division, to date, basic research on technology for energy production or utilization has been the focus, with little to report concerning land use.

In the Land Use program, a study entitled "Land Use, Energy Flow, and Policy Making in Society" has been completed on contract with the University of California, Davis. A model named "SPECULATER" was developed, the acronym representing "Simulation Program Examining the Causalities Underlying Land, Agriculture, Transportation and Energy Relationships." One basic hypothesis reported is that as oil imports increase, agricultural exports will increase to offset the trade balance. Numerous predictions have emerged, such as the end of urban sprawl by 1985, a dramatic drop in energy consumption, nearly doubled mass transit utilization by 2000, urban population densities of about a third higher in 2000 than now, and others.

In an interoffice NSF project, handbooks for local and State officials are being prepared on energy conservation. Contracted by the Environmental Law Institute, one handbook in the series is on land use as it relates to energy conservation strategies. Techniques that can be employed by State and local governments, largely legal maneuvers such as tax incentives, zoning potential, and model legislation, are presented in the handbooks.

Council on Environmental Quality (CEQ)

The Council on Environmental Quality, located in the Executive Office of the President, is the Nation's "watchdog" over environmental affairs. Established by the National Environmental Policy Act of 1969, it consists of three members and a relatively small staff. Among its duties are reporting annually to the President and Congress on the state of the environment, and formulating and recommending national policies to promote environmental improvement. The CEQ performs continuing analyses of changes or trends in the Nation's environment, and of activities which have impacts on the environment.

As the relationship between energy and environmental quality has become increasingly clear, the CEQ has been involved more and more heavily in energy projects. Its studies on energy have generally involved land use components.

The Council was the lead agency for development of a data base on energy development that includes land-use effects. This effort has had three principal products to date. An initial study, prepared by Hittman Associates in 1974 under contract to CEQ and EPA, (entitled "Environmental Impacts, Efficiency, and Cost of Energy Supply and Land Use") produced a large amount of data, largely in tabular form, which detailed energy-related environmental impacts on land, water, air and solid waste.

The next stage was the development of MERES—Matrix of Environmental Residuals for Energy Systems—to provide an analytical system for the raw data. This has produced a computerized data base specifying the water pollution, air pollution, solid waste, land use and occupational health effects of present and future energy systems. The data are stored in the Brookhaven National Laboratory computer system and incorporated into its energy models data base system.

The third stage in utilization of these data was issued in May 1975, as an interagency effort spearheaded by CEQ and also sponsored by the Energy Research and Development Administration, Environmental Protection Agency, Federal Energy Administration, Federal Power Commission, Bureau of Land Management, Interior Department's Office of Research and Development, and the National Science Foundation. Entitled "Energy Alternatives: A Comparative Analysis," the report gives a narrative summary of a wide range of variables and consequences associated with each of the major energy resource systems now in use or under active consideration. Included is a consideration of land use impacts involved in each of these energy resources.

Another CEQ effort, cosponsored by the Federal Energy Administration, is the "Western Regional Energy Development Study," contracted to the Radian Corp. The first phase, issued in August 1975, contains a section on land use impacts of various types of energy development scenarios in a chapter on environmental impacts. The final phase of the study is designed to deal with secondary impacts, and is expected to describe the land use consequences arising from support industries, increased urbanization, and other effects of energy development.

The extension of the Costs of Sprawl report, which includes the energy effects of various land use configurations, is another interagency effort in which CEQ is a leading participant.

Past studies sponsored by CEQ relating land use to energy development include a multivolume report on development of oil and gas resources on the outer continental shelf (OCS), of which one volume deals with onshore land consequences; a study of deepwater ports and their onshore environmental and land-use impacts; offshore siting of nuclear powerplants and attendant environmental hazards; and a study of the siting and safety of liquid natural gas facilities.

In general, CEQ has a broad mandate which permits consideration of a wide range of energy/land use relationships. It has both an energy programs and a land use programs staff, both of which have been active in the programs listed above, and which may become involved in a wide range of additional topics related to land use and energy.

Department of Commerce: National Oceanic and Atmospheric Administration (NOAA)

Management of Coastal Zone Planning efforts under the Coastal Zone Management Act of 1972 is the direct responsibility of the National Oceanic and Atmospheric Administration (NOAA). It is therefore a key Federal land-use agency with planning-related activities in the coastal states, where impacts of energy facility development are particularly concentrated.

The NOAA was established in reorganization Plan No. 4 of 1970, which brought together a large number of research, information and weather facilities into one agency, and placed it in the Commerce Department. However, a large number of ocean-related programs remain outside NOAA, among them the mineral leasing functions for outer continental shelf (OCS) energy resources.

In the Coastal Zone Management Act, NOAA is made the Federal agency responsible for awarding grants for planning coastal zone land use management and providing guidelines for participating States. NOAA also awards grants not only for coastal zone planning generally, but also for specially designated planning efforts aimed at ameliorating the onshore effects of OCS energy development and the construction of related facilities. The latter grants are given on a two-thirds Federal, one-third State matching basis, and are related to population size of the coastal counties concerned and the location of leases for OCS development. However, the guidelines for state planning under these grants specify only the planning processes that must be carried out—boundaries defined, facilities identified, etc. They do not dictate specific land use/energy relationships, or provide policy guidance. The program requires only that the interrelationships should be taken into account by the grant recipient.

NOAA also participates through its Office of Coastal Zone Management in contracting studies related to land use impacts of energy development. It is sponsoring a study of energy facility siting criteria for coastal areas, and it is a participant with the National Science Foundation and the Bureau of Land Management in a broad study of onshore impacts of OCS development.

Department of Housing and Urban Development (HUD)

The Department of Housing and Urban Development has several areas of concern which deal quite directly with both energy and land use activities and which are increasingly addressing the interaction between them. HUD administers planning grants under section 701 of the Housing Act, which provide funds to local governments for areawide planning, a process which includes the consideration of energy and environmental impacts. HUD also carries out research and demonstration projects for urban technologies which aim to enhance design and resource use capabilities, and it deals with building code standards to increase conservation of energy.

Within the past year, there has been an upsurge within HUD of programs in these areas, particularly in the efforts to increase inclusion of energy considerations in areawide planning.

Under the Assistant Secretary for Community Planning and Development, in the Office of Planning and Management Assistance, several efforts are underway to integrate energy planning in local functional and land use planning. An interagency memorandum of understanding between the FEA and HUD was signed in mid-1975, which lists several areas of cooperation between the agencies. These include sharing of information between the agencies and among their clients, and integrating of energy planning in "701" planning, and in making "701" planning money available for formulation of community energy plans.

In implementing the agreement, HUD sent a letter to each Governor, indicating that energy planning can be done with the use of section 701 funds; and a number of training efforts for local planners were set up for joint participation by FEA and HUD to introduce methods of inclusion of energy considerations into planning for growth needs and land uses.

A handbook for use in such training sessions has been developed by HUD, focusing on planning for energy needs and for accommodating impacts associated with energy resource development. This is the first handbook in a series of such guides which will address different planning topics.

Several demonstration projects dealing with energy in planning have been undertaken by HUD. A Mid-Atlantic Governor's Resources Coordinating Council was convened under HUD and FEA auspices to consider the off-shore development of energy resources and how to deal with onshore impacts associated with it in New York, Delaware, New Jersey, Pennsylvania, and Virginia. A separate effort for California was undertaken with the same objectives. In Utah, a series of meetings on the planning needs associated with actual and potential strip mining in that State were held. In all of these sessions, the discussion centered on planning to ameliorate these impacts, and the use of Federal and other funds to achieve the needed planning and to carry out actual programs. A land use/energy workshop for State and local agencies was planned to deal further with these questions.

Another category of energy-related activities is underway in HUD in the Office of Policy, Development and Research, to foster development of urban technologies which can provide for more efficient resource use, reduce the need for energy, and supply energy more efficiently.

Several efforts are related to these objectives: a residential energy consumption study in cooperation with the National Science Foundation, and the Environmental Protection Agency to assess various methods of reducing energy consumption; a system analysis contracted through the Oak Ridge National Laboratory to evaluate ways of using thermal energy from powerplants in urban heating systems; and examination of total energy systems for on-site power generation in residential developments, jointly developed with the National Bureau of Standards.

The modular integrated utility system (MIUS) program, underway for over 2 years, is another interagency effort with important implications for land uses related to energy production and utilization. The MIUS is a utility system which combines processing plants that generate electricity, use residual and recycled energy for heating, air conditioning, and hot water, water treatment, and process solid and liquid wastes. It can be located near appropriate users to minimize the utility service distribution infrastructure. A number of demonstrations of MIUS are underway. Federal participants are HUD, the National Aeronautics and Space Administration, National Bureau of Standards, Atomic Energy Commission (now the Energy Research and Development Administration) and the Environmental Protection Agency.

All of these efforts, although not directed specifically toward their land use consequences, would have significant implications for the interaction of energy production or utilization and land use patterns in communities.

Department of the Interior: Bureau of Land Management (BLM)

The BLM is a central Federal land agency and a key energy resource agency. It is responsible for overall management of some 470 million acres in the public domain; it also manages the energy resources of all the federally owned lands, including the National Forests, acquired lands, and the outer continental shelf (OCS). The federally owned lands in the West and Alaska, together with the OCS, contain vast quantities of the Nation's coal and oil resources. The BLM is charged with making the decisions on which tracts of land in these areas are to be leased by the Federal Government for the private exploration and development of the energy resources they may contain. These are both important energy decisions and critical land-use decisions.

A BLM planning system has been devised to provide the framework for these decisions, using multiple-resource-use objectives. The system has been in use since 1969, and by 1974 some half of the public lands under BLM management were included in the first-generation plans. Called management framework plans (MFP's) they include policy guidance components which provide national objectives for each resource activity; information components which include resource inventories for each planning unit; general social and economic data detailing numerous factors and problems and trends affecting the national resource lands; and applied social and economic data, including analysis of national and regional energy requirements and alternative sources.

From this information emerges a plan detailing the interactions and consequences of policymaking decisions in each of these resource areas. Manuals are prepared by the Washington Office of BLM for guidance to the regional offices in preparing the MFP and in the application of it.

The Bureau has devised, for example, the energy minerals activity recommendation system (EMARS) to work within the land use planning and programming systems to determine the location, size, timing, and rehabilitation factors of possible Federal coal leasing areas. The

system operates through a multiple resource evaluation at the field office level. The field office examines and evaluates data on: rehabilitation potential of a proposed area following lease and coal production activities; the resource base, including other resources such as range, wildlife, forestry, et cetera; surface and mineral ownership; socioeconomic impacts of coal development on the surrounding area; state and local government requirements; national, regional and local demand for Federal coal. Using these considerations, areas of resolved conflicts and high coal development potential are derived, and this information is available for utilization in coal leasing decisions.

In the Office of Economic Analysis, the Program and Policy Analysis Division has instituted a Socioeconomic Studies Program, which is developing the methodology permitting inclusion of variables in environmental impact statements for each lease sale by BLM. A section on land use impacts and requirements is expected to be included in this methodology. Also under this program, on-shore impacts of offshore energy development related to OCS lease sales are studied. The BLM is a participant in a study under the National Science Foundation and the National Oceanic and Atmospheric Administration to develop methods of estimating the on-shore impacts with some degree of reliability. Another study of on-shore impacts in a specific area was undertaken by the University of Alaska for areas in Alaska, using BLM funds, to estimate the land use requirements associated with Alaska energy development.

Department of the Interior: U.S. Geological Survey (USGS)

Since its origins in 1879, the Geological Survey has been a key land and resource agency of the Federal Government. It is currently carrying out a greatly expanded version of its original mandate to examine "the geological structure, mineral resources, and products of the national domain." It conducts geological surveys, develops the data and knowledge for evaluating water and mineral resources, and classifies the Federal lands as to their value in terms of leasable minerals. The USGS also regulates private leases for oil and gas operations on Federal lands, including the outer continental shelf, acquired lands, Indian lands, and others. It grants permits for prelease exploration and postlease drilling operations in the OCS, and carries out inspections to insure compliance. Its over-all objectives in carrying out this regulation are to ensure maximum utilization and prevent waste of mineral resources, to limit environmental damage during the extraction phase, and to protect public health and safety.

In connection with these duties, the USGS operates a broad energy/land use program for information and data. Under the land and resource analysis program there is an interagency effort called Resource and Land Investigations (RALI). This effort has the mission of improving the resources and land information base for use in policymaking, planning, and decisionmaking. Begun in 1972, the program is carried out by all the agencies of the Interior Department, with USGS as the lead unit. Its objectives are to coordinate, acquire, and array topographic, geologic, hydrologic, biologic, geographic, and other data in order to provide comprehensive information for decisionmaking.

RALI places emphasis on critical areas, and according to one planner in the program, over half of its work relates to energy.

RALI products are geared toward use by the resource and land planner at the State and local levels. The major publication is a series of guidebooks in specific subject areas describing the state of the art in planning and integration of various factors for the chosen activities. Utilizing major input by various Interior Department agencies and some contracted studies, several guidebooks on land use and energy questions have been produced, dealing with:

—Siting of energy transmission corridors, prepared under the supervision of the Bureau of Land Management. This guidebook covers transmission lines, pipelines, and all the major factors involved, including physical economic and social variables to be included.

—A critical environmental areas study, prepared by the USGS Office of Land and Water Resources Planning. This guidebook is to facilitate state level land use planning in ecologically fragile areas.

—State land inventory and data handling. This guidebook will identify the needs for data and information in state planning.

—On-shore impacts of outer continental shelf development, prepared by the New England River Basins Commission. This effort is designed to provide guidelines for planning to accommodate the on-shore impacts of offshore energy resource development, identifying the factors to be considered.

An annotated study, in addition to the guidebook efforts, has been contracted to the Mitre Corp., titled "An Approach to Environmental Assessment with Application to Western Coal Development." A primer on the status and progress of all State mined-area reclamation efforts, and a study on the relationship of local planning to State reclamation efforts are other BLM efforts.

The Land and Resource Analysis Division has another program in USGS which is designed to provide for USGS the kind of coordination of the same objectives that RALI provides for the entire Interior Department. This program is geared more toward the urban areas, according to a planner in the program, and toward assessing the resources that are part of them. Energy is not a very significant aspect of this effort, although its role is growing to some extent. The Puget Sound area, for example, is being studied to identify actual or potential on-shore impacts from energy development. However, the emphasis is on the earth-science aspects only, assessing the geologic dangers of locating refineries, or other energy-related development in certain areas.

Other USGS divisions have programs in energy which deal with the interconnection with land resources, such as the energy lands program in the Geologic Division which is assessing the environmental constraints on energy development. The Water Resources Division is doing a project on the interaction of coal mining and oil shale development with water needs in the Yampa River Basin in Colorado, using baseline data collection and simulation modeling. In the Geothermal program, environmental impacts are being assessed. The USGS Computerized Resources Information Bank (CRIB) is designed to include

both domestic and international entries on minerals and material resources, information that could be widely applied in energy and land use decisionmaking.

Other Agencies

In addition to the agencies already described, there are others which deal occasionally with the energy/land use interconnection as a peripheral concern to their main functions. Some of these have major land use or energy functions, but they are not among those which have dealt explicitly to a significant degree with the interactions between land use and energy.

Among such agencies are the following:

Department of Agriculture.—Policies for the uses of agricultural lands are often interconnected with availability of energy resources for use in operating farm machinery and for use in fertilizers. The Department also houses the Forest Service, a major land use management agency. In July of 1975 the Forest Service published "National Forest Landscape Management: Utilities." This was volume 2, chapter 2 of a series of handbooks for dealing with specific functions or areas of concern to the Forest Service in its resource management activities. It dealt with ways to plan utility system routes and facilities so as to minimize disruptions of the lands under its jurisdiction.

Energy Resource Council.—The Council was established in the Energy Reorganization Act of 1974. It is composed of the heads of most major Federal departments and agencies and charged with the consideration of energy policy at the highest level. In this role the council will often consider the many policy areas in which land use and energy interact or conflict.

Department of Transportation.—A list of the many ways the DOT carries out its functions in ways that impact on energy and land use would be very extensive. However, the Department itself has not been considering these two concerns—as they interact—to any great extent in current activities. Energy-saving mass transit systems are a major concern in the Department; but this is not being discussed in the context of influencing land use patterns at the present time.

Tennessee Valley Authority.—The TVA does some kinds of planning for the areas under its jurisdiction and assists planning efforts by local governments. Since TVA is a major producer of electricity in the area, it has several functions which do integrate energy and land use considerations. However, it has not emerged as a major contributor to efforts concerning general energy/land use policies for areas beyond its own jurisdiction.

CHAPTER V.—VECTORS FOR POLICY INTEGRATION*

Introduction

A conclusion that may be drawn at this point is this: Not only is it necessary to integrate energy planning with land use planning in the United States, but in tentative, often crude ways, integration is beginning to happen through state legislation and through Federal agency programs. There are for governmental policymakers, existing "vectors" for integration already in place. Chief among them are transportation, water resource planning, and environmental controls. By manipulating transportation policy, for example, one can save both energy and land. Mass transit, in metropolitan as well as interurban terms, can produce energy-and-land-efficient settlement. In contrast, continued emphasis on automobiles and limited access highways in transportation policy would simply continue the sprawl-causing, energy-wasteful settlement pattern that exists today.

Water resource allocation policy, too, is a vector for governmental intervention in land and energy decisionmaking. A policy tipped too far in behalf of water-demanding energy development can reduce agricultural production, a critical issue in these days of world food crisis. Further, a water policy inducing urban or industrial land uses—brought about by a commitment to energy facility siting in agricultural areas—has caused concern among agricultural experts about the effects of pollution.[1] E. A. Schuck believes that many crops, though not always showing it, "suffer up to 50 percent reduction in growth rate and yields" because of pollution.

T. W. Edminster told a House committee that "air pollutants cause an estimated $500 million annual loss to agriculture." Walter W. Heck of the U.S. Department of Agriculture states: "The potential effect of an increase in oxidant and, or sulfur dioxide concentration is difficult to forecast. At some level the genetic resistance within a species is not sufficient to cope with a pollution insult."

Water, so necessary to energy development, to agriculture, and to urban development, is a means by which policymakers can balance the need for energy and the need for environmental quality especially in high-productivity agricultural areas.

A third vector is statutory environmental controls. These controls, primarily air and water pollution laws together with the NEPA environmental impact statement process, can be used to create a balanced land and energy development and conservation policy. Air and water pollution standards can control the location of facilities—including

*This chapter was prepared by Connie A. Musgrove, Howard A. Brown, and W. Wendell Fletcher whose contributions are noted throughout the text. The introduction is by Charles E. Little.

[1] See Biniek, Joseph P. in Potential Effects of Application of Air and Water Quality Standards in Agriculture and Rural Development. U.S. Senate Committee on Agriculture and Forestry. U.S. Govt. Print. Off. Washington, 1975. pp. 15–19. The quotes are from papers collected by Mr. Biniek and cited in his introduction.

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energy facilities—and in not-so-subtle ways control the primary uses of land as well, leading to energy conservation.

This chapter of the report describes how these three vectors for land and energy policy integration work. The point on describing them is that these mechanisms are already in place at the Federal level and in many states as well. The three vectors, among others, are a means by which Federal and State Governments can create land and energy policy right now, without further statutory authority. And yet this approach should not imply that no new legislation is called for. Necessarily, the manipulation of land and energy policy by means of "vectors" is fragmented, difficult to coordinate, and ultimately may not produce a result wholly in accord with national sentiment on the thorny issues of growth.

The fact is that energy development and land development go hand in hand, as do land conservation and energy conservation. Though, the American consensus on development versus conservation is anybody's guess in these changing times, some day the Congress may be able to express a means to achieve consensus in legislation requiring comprehensive planning for land and energy. Meanwhile, the Federal Government and other governments, can, by using the vectors for policy integration effectively, at least avoid the infinitely worse alternative of abrogating land-and-energy decisions to those whose concern for the public interest may be quite narrowly construed.

Transportation*

THE ISSUE

The search for footholds from which to formulate a coordinated national energy and land development program has lead to the examination of various program planning interfaces. Because of both the amount of energy it commands and the direct influence it has on the shape of land development, Federal transportation policy emerges as a prime candidate. What is even more significant about the use of transportation as a policy vector for energy/land use coordination is that, historically, the Federal role more than any other factor in U.S. transportation planning has determined the shape of the country's transportation network. Thus, Federal policy has been the major determinant of the energy consumption and land settlement patterns characteristic of the present system.

In order to assess the degree to which transportation would be a successful policy vehicle for addressing the energy/land conservation issue, it is necessary to examine the existing relationships among transportation, energy consumption and land use: to analyze the capability of present national transportation policy to respond to national needs; and to determine the extent to which transportation research and development plans are sufficiently innovative and flexible to be part of a comprehensive proposal for future energy/land conservation and development.

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*This section of Chapter Five was prepared by Connie A. Musgrove, Analyst in Environment and Natural Resources Policy, Congressional Research Service.

THE RELATIONSHIP: ENERGY

Transportation consumes 25 percent of the total energy used in this country. Since 1950, the average annual growth rate in transportation energy consumption has been approximately 3.23 percent, with a sudden upsurge to 4.5 percent between 1965 and 1972.[2] Within the transportation sector—both inter- and intra-city freight and passenger—automobiles use 55 percent of all energy, trucks 21 percent, aircraft 7.5 percent, and rails approximately 3.3 percent of transportation energy consumption.[3] The growth rate within each of these sectors varies considerably favoring the less energy efficient modes. Tables I–III illustrate their relative shift over time.

Coupled with the increased growth rates of the more energy consumptive modes has been the dramatic decline in transit ridership during the last thirty years. In 1950, transit ridership reached more than 17 billion passengers carried. This figure fell to nearly 6.5 billion in 1972 with only a very slight increase between 1972–74.[4]

In the mid-1970's, the transportation sector by some estimates uses about 55 percent of the petroleum consumed in the United States. Before the Arab oil embargo and the sudden national attention towards energy conservation, government projections placed the percentage of petroleum supply used in transportation at 72.3 by the year 2000.[5] Since the Arab oil embargo, projections for future energy consumption and growth rates have been revised. Discrepancies among various government, industry and other research projections illustrate the confusion existing over what our actual future energy situation will be in 1985 or 2000 based upon any of the proposed energy use scenarios.

TABLE I.—INTERCITY PASSENGER TRAFFIC AND ENERGY CONSUMPTION [1]

Year	Total passenger-miles (10^9)	Percent of total passenger-miles				Total energy [2] (10^{12} Btu)	Inverse efficiency (Btu / passenger-miles)
		Automobile	Airplane	Bus	Railroad		
1950	510	86.1	2.0	5.2	6.4	2,040	4,030
1955	720	89.5	3.2	3.6	4.0	3,000	4,210
1960	780	90.1	4.3	2.5	2.8	3,390	4,340
1965	920	88.8	6.3	2.6	1.9	4,100	4,470
1970	1,180	87.0	9.7	2.1	.9	5,510	4,690
Continuation of current trends:							
1980	1,710	85.0	13.0	1.5	.5	8,370	4,890
1990	2,240	84.0	15.0	1.0		11,280	5,040
2000	2,770	83.0	17.0			14,340	5,180

[1] Data from Statistical Abstract (1970) and from Transportation Facts and Trends (1971).
[2] Data from Rice (1970) as approximate values for mid-1960's.

Source: Hirst, Eric. "Energy Consumption for Transportation in the U.S.," ORNL–NSF–EP–15, Oak Ridge, Tenn., March 1972. 34 pp.

[2] Ford Foundation. Energy Policy Project. Final Report. A Time to Choose: America's Energy Future. Cambridge, Mass., 1974. 511 pages.
[3] Hirst, Eric. Energy Consumption for Transportation in the U.S. ORNL–NSF–EP–15. Oak Ridge, Tenn., March 1972, 34 pages.
[4] American Public Transit Association. Transit Fact Book. 1974–1975 Edition. Washington, D.C. March 1975. 31 pages.
[5] U.S. Department of Interior. Bureau of Mines News Release, March 9, 1971 and circular 8384, 1968. As quoted in "Energy Consumption for Transportation in the U.S. Eric Hirst. ORNL–NSF–EP–15, 1972, page 3.

TABLE II.—ENERGY REQUIREMENTS OF PASSENGER TRANSPORTATION MODES [1]

	Miles per gallon of fuel or equivalent		
	Passengers	Vehicle	Passenger
Heavy rail transit (subway) car, peak load [2]	135.0	4.00	540
Intercity passenger train [3]	540–720.0	.50	270–360
Transit bus, peak load [4]	75.0	4.10	307
Intercity bus [5]	47.0	6.00	282
Commuter rail car diesel powered [2]	125.0	2.00	250
Heavy rail transit (subway) car, offpeak load [2]	35.0	4.00	140
Transit bus, offpeak load [4]	30.0	4.10	123
Rail turbine train [3]	320.0	.33	110
Standard size automobile intercity maximum load [6]	6.0	18.00	108
Standard size automobile urban, maximum load [6]	6.0	14.40	86
Wide-body commercial jet aircraft, 1,000 miles flight [7]	256–385.0	.14–.22	54–60
Twin jet commercial aircraft, 500 mile flight [7]	68–106.0	.44–.54	37–47
Average commuter automobile [2]	1.4	13.5	19

[1] Transit Fact Book, 1974–75 edition, American Public Transit Association, Washington, D.C., March 1975, 31 pp.
[2] Commonwealth of Pennsylvania, Department of Transportation.
[3] National Railroad Passenger Corporation (Amtrak).
[4] Cleveland Transit System.
[5] U.S Department of Transportation, Transportation System Center.
[6] U.S Department of Transportation, Federal Highway Administration.
[7] National Aeronautics and Space Administration.

TABLE III.—ENERGY-EFFICIENCY OF VARIOUS AIRCRAFT [1]

Type of aircraft and year	Inverse efficiency (Btu/seat-mile)	Speed (miles per hour)
DC–3, 1940's	2,630	150
DC–6, 1950's	3,130	270
DC–7, late 1950's	3,030	330
Electra, 1960's	3,330	400
DC–8, 1960's and after	4,000	525
B–747, 1970 and after	2,700	575
SST, proposed	6,250	1,200

[1] Data from historical perspective in transport system development (1970) as reported in energy consumption for transportation in the United States (Hirst, 1972).

Much of the discrepancy is concerned with predicted increases in miles per gallon of autos, the percentage of compact or subcompact size vehicles, alternative public transport available, and the development of alternate fuels technology, et cetera. Thus, recent events have made the forecasting of the long-term level of transportation fuel consumption speculative.

THE RELATIONSHIP: LAND USE

The relationship of transportation to land use is threefold. First, present transportation systems, by nature, require space. Highways, local streets, parking lots, et cetera account for 25 percent or more of land uses in urban areas. In 1968, there were over 3½ million miles of roads and streets in the nation supporting nearly 2.8 billion daily vehicle miles of travel. Approximately 350,000 million miles and 45 percent of vehicle miles traveled were in urbanized areas of over 50,000 population. To accommodate the projected doubling of vehicle miles traveled between 1970 and 1990, the U.S. Department of Transportation estimates that the mileage of urban arterials and collectors,

for example, will increase by close to 90 percent with local street systems increasing 75 percent given the 50-percent increase expected in travel.[6]

The second relationship stems from the development patterns arising from the transportation corridors. One of the serious concerns of land conservationists is strip development—the tendency for uncontrolled commercial, industrial, as well as residential growth to spring up along highways and freeway interchanges, aggravating the problem of urban sprawl. In hearings on the future highway program conducted by the Senate Committee on Public Works, the National Resources Defense Council testified that Federal transportation money has been spent in a way that encourages low-density land use, with metropolitan areas spreading out to cover huge land areas. From 1950 to 1970, this sprawl grew from 18 million to 35 million acres. If present trends continue, it is estimated that this sprawl will triple in size from 1970 to the year 2020.[7]

This predominantly low-density development characterizes the interrelationship of transportation, land use, and energy consumption and gives rise to the third interface. As development has caused different activities to be separated from each other and more and longer auto trips are made because low density development does not usually generate sufficient demand for transit service, this sprawl pattern consumes a greater amount of energy for transportation purposes. The "Costs of Sprawl", a cost analysis study of land development prepared for the President's Council on Environmental Quality, examined the travel characteristics of different community prototypes. The findings indicate that with regard to gasoline consumption related only to transportation within the model communities of 10,000 dwelling units, the low density unplanned pattern consumed approximately 855 barrels per day of petroleum as compared with 695 barrels per day for low density clustered developments, a savings of 19 percent.[8]

NATIONAL TRANSPORTATION POLICY : CURRENT LEGISLATION

The pressing constraints of energy, land use and environmental quality are requiring that present and future transportation development and planning must expand its goals beyond the movement of people and goods safely, efficiently, and with the greatest freedom of mobility. While the need for multidisciplinary planning was foreseen early in the Nation's transportation history, it has never been thoroughly established in the planning process. Much of the problem lies in the lack of any coherent national transportation policy and a coordinated framework with which to carry it out.

Federal involvement in transportation has traditionally consisted of a conglomerate of unrelated transportation programs characterized by intensive support of highway construction. It was the 1962 Federal-Aid Highway Act that legislated what up until that point had been

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[6] U.S. Department of Transportation, Federal Highway Administration. 1972 National Highway Needs Report. March 1972. Washington, D.C. p. 4.

[7] Regional Plan Association. Implementing Regional Planning in the Tri-State New York Region. (April 1975.p. 10 as quoted by National Resources Defense Council before the U.S. Senate Committee on Public Works. Subcommittee on Transportation. Hearings July 1975. Future of the Highway Program. Washington. D.C. U.S. GPO 1850 p.

[8] Real Estate Research Corporation. The Costs of Sprawl. Prepared for the Council on Environmental Quality. U.S. Department of Housing. and Urban Development, and U.S. Environmental Protection Agency. April 1974. U.S. G.P.O.

rhetoric and voluntary action—comprehensive planning. Section 134 of Title 23 reads * * *

> After July 1, 1965, the Secretary of Transportation shall not approve . . . any program of projects in any urban area of more than 50,000 population unless he finds that such projects are based on a continuing comprehensive transportation planning process carried out cooperatively by the states and local communities . . .

This has come to be known as the "3C" or "134" planning process. The Department of Housing and Urban Development and the Urban Mass Transportation Administration provide funds to finance regional planning agencies. By 1973, in half of the urbanized areas, the 3C planning agencies and the transit planning agencies were under the same roof; but in the other half, they were separate organizations, thus limiting the possibility for proper coordination.

The 1973 Federal Aid Highway Act made two contributions in the area of urban transportation planning. It provided that one-half percent of the funds authorized to be appropriated for the Federal-aid systems shall be available to carry out the "134 planning process." In addition, it said these funds, apportioned to the States, shall be made available to the "metropolitan planning organization designated by the states." Thus, the 1973 amendment provided the basis for the Secretary of Transportation to direct the Governors to designate a single planning agency in all urbanized areas that would be recipients of highway and mass transit planning funds. It took 11 years since the original provision in 1962 was enacted to bring highway, transit, and land use planners together.

The 3C transportation planning as currently carried out is viewed by many to be inadequate because it fails to recognize the comprehensive nature of urban systems and, in particular, the interdependence of land use, transportation—including all modes of travel—as well as environmental factors. In addition, this mechanism, in its present state, has limited ability for integrating energy consciousness into the system without initiating energy conservation goals and implementing them through mass transit development—an objective not yet totally embraced in national transportation legislation.

Up until the time of the Federal Aid Highway Act of 1974, States were left with little choice but to choose the 90 percent Federal assistance for the building of interstate links to meet their needs for expanding transportation facilities. It was only after long, drawn out, and highly emotional debate, that the door of the highway trust fund was opened to divert funds to public transit assistance as well as to substitute certain proposed urban interstate links with public transportation projects. Ironically, the arguments supporting such legislation were all based on the needed flexibility to integrate transportation planning with other national and regional objectives—a principle supposedly already written into law.

NATIONAL TRANSPORTATION POLICY: PROPOSALS

It is in this atmosphere of Federal recalcitrance that one examines three recent national studies for their analysis of the transportation/

energy/land use interface and their proposals for effectuating a comprehensive national plan. "The 1975 National Transportation Policy Report", the Rockefeller Task Force Report, "The Use of Land," and the Energy Research and Development Administration's National Plan for Energy Research, Development and Demonstration represent three approaches to addressing the stated interrelationships. First, from the standpoint of transportation policy; next, from that of national energy development and conservation; and, finally, from the viewpoint of land development and conservation.

The National Transportation Policy Report was published in September 1975 by the U.S. Department of Transportation. It is the first attempt by the Federal Government to define the needs in national transportation planning and to establish guidelines for a national policy. Admittedly, it is a preliminary document. However, certain basic premises are clear: (a) the automobile will remain the primary source of transportation for most Americans for the foreseeable future; (b) completion of the Interstate Highway System will have the highest priority; and (c) private capital and the market place should be the principal mechanisms for providing the development and maintenance of the Nation's transportation systems.

Energy conservation is a key issue throughout the report. Five near and midterm options are outlined and directed primarily at the automobile.[9]

—a national 55 mile per hour speed limit
—automobile fuel economy improvement (40 percent improvement in new car mileage by 1980)
—carpooling promotional and information programs
—improved urban traffic management and transit service as a condition of urban highway and mass transit funding; and
—a seven point Federal aviation jet fuel conservation program (this category mainly emphasized ground and taxiing control, optimum cruising speeds, and altitudes and air traffic flow procedures, rather than the development of more fuel efficient aircraft).

The program options are largely geared toward voluntary or good faith efforts based on general energy conservation guidelines consistent with Project Independence's 1985 deadline. They are not nor do they appear intended to be a long range aggressive Federal effort toward altering transportation patterns or attitudes to meet an eventual world petroleum shortage or depletion.

The report seriously neglects the land use question. One statement summed up the objective—"Our continuing policy will be to provide increased flexibility to local officials in the use of Federal-aid urban transportation funds, enabling these funds to be used for either highway or transit needs as best services local transportation and land use objectives." [10] No attempt was made to emphasize the connection between transportation trends and the resultant sprawl development or to link transportation energy consumption with land use development patterns. While the Department will continue to integrate its trans-

[9] A Statement of National Transportation Policy by the Secretary of Transportation. U.S. Govt. Print Off. Washington, D.C. p. 39.
[10] Ibid., p. 38.

portation planning into overall land use planning, a questionable activity based on its previous track record, it considers the institutional barriers to be primarily local ones.

The Rockefeller Task Force Report, "The Use of Land," [11] is an examination of opportunities for improvements in urban growth and development and in protecting the country's natural, cultural and aesthetic resources. The study was undertaken and written before the 1973 Arab oil embargo dramatized the seriousness of the energy situation and launched the nation into an energy conservation consciousness. Thus, the energy leg of the transportation/energy/land use conservation equation is only briefly referred to in terms of a need for further incentives to develop more dense, self-contained communities.

The study's attention to the interface between transportation and land use conservation and development is not extensive. Consideration is limited primarily to discussion of transport needs for low-density development. The report does recognize that new transportation arteries afford government the opportunity to channel development forces. This opportunity is contingent, however, upon government entities with powers of eminent domain, and authority to override local land use regulations and to control public utilities, etc. These authorities are recommended by the report.

A larger role could have been assigned the impact of transportation on various types of land use planning. The report, in only superficially treating this area, neglects the full consideration necessary for the truly comprehensive and integrated land use planning it advocates.

The purpose of the ERDA study [12] is to devise a comprehensive national energy research, development and demonstration plan to deal effectively with the present and future energy problems of this country. Near term, mid-term, and long range energy needs are identified together with options and implementation plans for meeting these needs.

ERDA has properly identified transportation as one sector of the economy requiring energy conservation strategies and new technological developments. The three objectives are to (a) by 1985, develop options to reduce petroleum consumption in autos, trucks, and buses; (b) by 2000, to eliminate the dependence on petroleum as the primary energy source for all elements of transportation; and (c) after the year 2000, to improve energy conversion efficiencies and support new technologies which use non-exhaustible, domestically available energy resources.

The ERDA proposal has major shortcomings. It is geared towards maintaining the same automobile and highway dominated transportation network. Strategies are tied solely to technology—improvements in fuel economy, propulsion systems, and fuel sources. There are no initiatives or programs for improving energy conservation through changing the concept of one man one car, through devising new concepts in energy efficient travel patterns for either established settlements or for future land development, or through developing inno-

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[11] The Rockefeller Brothers Fund. The Use of Land: A Citizens' Policy Guide to Urban Growth. A Task Force Report. Ed. by William K. Reilly. New York. 1973. 318 p.

[12] U.S. Energy Research and Development Administration. A National Plan for Energy Research, Development and Demonstration: Creating Energy Choices for the Future. ERDA–48. U.S. Government Office. Washington, D.C. June 1975.

vative transportation collector systems. In brief, the three way connection of transportation/energy/land use is not addressed or recognized. The two way relationship of transportation/energy is considered only in terms of what energy technologies are needed to continue our existing transportation system.

Though these studies are only three out of literally hundreds of official and quasi-official reports comprehensive enough to deal with the transportation/energy/land use interrelationship, they are perhaps representative. As such, it would appear that the Federal Establishment has not yet grasped the opportunities that transportation policy presents to achieve an integration of energy and land use conservation and development. Possibly the new generation of studies, now being readied as discussed in chapter four, will be able to bring these policy elements closer together.

Water Resources Policy*

Limited water supplies have been and continue to be a problem for western fossil fuel development. Similarly, water availability is a primary land use determinant in the West. Thus, in the Western States water resources are the sine qua non of both energy development and land utilization.

The Colorado and Upper Missouri River Basins, in which most of the energy resources are located are both water scarce areas with regional economies presently based upon irrigation agriculture. In the northern Great Plains alone there is an estimated 1.5 trillion tons of coal, some 40 percent of U.S. coal reserves—the entire West has nearly 60 percent—most of this coal is low sulfur and much of it can be easily stripmined. Twenty-seven billion tons of western coal could be surfaced mined by current methods, enough to match current national coal production for 45 years. High grade oil shales in the Upper Colorado River Basin alone contain the equivalent of 600 billion barrels of oil, which is roughly equivalent to known reserves of oil for the entire world.

Thus, water resources policy will play an impressive role in determining land use patterns for much of the western United States. And because these western areas contain such a large percentage of energy resources, water policy will determine the nature and the scope of energy development for the entire United States.

United States water resources policy is composed of a complex interaction of State water rights law, federally reserved water rights, and various Federal programs for navigation, flood control, irrigation, hydroelectric production, recreation, and other purposes. But the most important elements of U.S. water policy are thousands of individual water resource development projects by various Federal and State agencies.

While this complex array of water projects suggests a lack of central policy, there are, however, two Federal water resource programs of major importance to water supply problems relating to energy development. First, the industrial water marketing program of the Bureau of Reclamation is directly pertinent to efforts to obtain water

*This section of Chapter Five was prepared by Howard A. Brown, Analyst in Environment and Natural Resources Policy, Congressional Research Service.

supplies for planned energy facilities. The Bureau of Reclamation controls most of the major reservoirs in the West and through its industrial marketing program has sought to provide the water necessary to exploit Western fossil fuels.

The second, the water resources planning program overseen by the Water Resources Council, provides a vehicle for coordinating water for energy projects with general water resource planning efforts which essentially relate to land use.

In addition to these two Federal programs, there are also several facets of water law through which Federal policies could have very substantial influence on energy and land-use decisionmaking.

These three areas of potential policy integration of land use and energy considerations are described below.

INDUSTRIAL WATER MARKETING

The Bureau of Reclamation in the Department of Interior is one of the principal Federal water resource development agencies. Operating chiefly within the 17 continental Western States, the reclamation program was established in 1902 in order to encourage development of the West by the provision of irrigation water for agriculture. Over the years additional purposes such as hydroelectric power production, flood control, recreation, and municipal water supply were added to the reclamation program since they could be provided easily in conjunction with irrigation projects and particularly with hydroelectric development, help pay for the irrigation works.

In recent years, it has been increasingly difficult to find new irrigation projects economically feasible or to get funding for them. The Bureau has already built numerous large reservoirs throughout the West to provide streamflow reglation and storage, to be utilized for anticipated projects. With the expectation that many of these future irrigation projects will not be built and with strong interest in the development of western fossil fuel resources, there has been considerable attention paid to making the water in these reservoirs available for energy development. To what extent this is the result of pressure put upon the Bureau by the energy companies or to what extent it is the result of strong sales effort by the Bureau in order to maintain a mission, is a matter of conjecture, but major efforts have been made toward that end.

Specifically, through the industrial water marketing program, the Bureau has granted or received application for water service contracts for substantial volumes of water for use in development of western fossil fuels. This is in keeping with the strong commitment to energy independence efforts by the Department of the Interior, of which the Bureau is part.

In an alliance which, until recently, would have been considered a case of strange bedfellows, environmental and agricultural interests have joined forces in attacking planned western energy developments and their use of water. The industrial marketing program is a primary target of this opposition. A pending court case, *Environmental Defense Fund et al.* v. *Morton et al.* (U.S.D.C., D. Mont., Civil No. 1220), is a focal point of this opposition.

Starting in 1967, the Bureau of Reclamation let option contracts for industrial water service totaling 623,000 acre-feet of water per year

from Bighorn Lake—Yellowtail Dam—in Montana and Wyoming plus 35,000 acre-feet per year from Boysen Reservoir in Wyoming to energy companies interested in development of northern Great Plains coal reserves. Applications were received for an additional 381,000 acre-feet per year.

The Environmental Defense Fund suit on Boysen-Yellowtail, filed in October 1973, seeks to halt water contracts from these two reservoirs. In addition to the Environmental Defense Fund, the plaintiffs include other environmental interests, irrigation and livestock companies, and various agricultural interests. The State of Montana was granted intervenor status. On the defendants' side in addition to representatives of the Bureau of Reclamation and the Department of the Interior, 12 major energy companies joined as intervenors. The case was argued December 11, 1975. Allegations of the case include: violation of requirements of each of the three general authorities for industrial marketing (43 U.S.C. 521, 43 U.S.C. 485 h (c), and 42 U.S.C. 3906(b) acts of 1920, 1939, and 1958); violation of the National Environmental Policy Act, The Fish and Wildlife Coordination Act and the Yellowstone River Basin Compact; and adverse effects on downstream agricultural water users. An allegation which aims directly at the authority for the industrial water marketing program is that industrial water supply was not a purpose of the reservoirs as authorized by the 1944 Flood Cntrol Act—the two reservoirs are components of the Pick-Sloan Missouri River Basin Program authorized by that Act—although the Bureau of Reclamation has written other industrial water contracts, the Boysen-Yellowtail contracts may have been among the first to cite a general authority (43 U.S.C. 485 h (c)) rather than specific project authority.

Also under the Pick-Sloan Missouri basin program and to serve northern Great Plains coal deposits, the industrial water marketing program is the subject of considerable controversy in regard to the reservoirs on the main stem of the Missouri River—Gavins Point, Fort Randall, Big Bend, Oahe, Garrison and Fort Peck Dams—these reservoirs were built by the Corps of Engineers but water from them was to be usable for irrigation projects of the Bureau of Reclamation. In February 1975, the Secretaries of the Army and the Interior entered into a memorandum of understanding on industrial water marketing from the main stem reservoirs "in order to expedite the use of water for energy development." This action drew considerable criticism including concern for exclusion of States from the decision process, Indian water rights, irrigation needs, and downstream navigation and hydroelectric power generation.

The Senate Interior Committee held oversight hearings on Missouri River Basin Industrial Water Marketing in Washington, D.C. in July 1975 and an additional day of hearings in Montana. At the hearings in Washington, the State of South Dakota expressed extreme reservations about the memorandum of understanding.

FOUR CORNERS

Since the 1960's, the industrial water marketing program has played a major role in the Southwest as well. In 1964, twenty-three western power companies formed a consortium known as Western Energy and

Supply Transmission Associates for joint-venture planning and construction of electrical generating facilities in the Southwest. There are six major coal fired steamplants associated with the consortium—Four Corners and San Juan in New Mexico, Navajo in Arizona, Huntington Canyon and Kaiparowits in Utah, and Mojave in Nevada. All but Kaiparowits are in operation or under construction and all but Four Corners get water service by industrial contract with the Bureau of Reclamation. Water for the Mojave plant comes from the Boulder Canyon Project; water for all the others comes from the Colorado River Storage Project or the associated Navajo Reservoir Project in Upper Colorado River Basin. The authorizations for these projects specifically include industrial water marketing as a project purpose.

In addition to the steam electric generating plants there are two proposed coal gasification plants for the Four Corners area: WESCO and El Paso. Both would be near Farmington, N. Mex. and both would use Navajo Reservoir water. The authorizing legislation for the Navajo Reservoir (Public Law 87–483) stipulated that no long-term contracts for water supply from the reservoir could be made unless approved by Congress on the basis of determination by the Secretary of the Interior that sufficient water would be available for use in the State of New Mexico under the terms of the Upper Colorado River Basin Compact—New Mexico is the one Upper Colorado Basin State which has already committed all or nearly all of its entitled water under the Upper Basin Compact.

Three contracts were recommended by the Secretary of the Interior and approved by Congress in 1968. One serves the Navajo steam-electric plant which will provide power for the Bureau's controversial Central Arizona Project. Another contract, with Utah Construction and Mining was planned for additional units at the Four Corners Plant. Instead the contract was recently renewed and amended, so as to be usable for the proposed WESCO gasification plant. The El Paso plant would require a new contract and congressional approval. The Department of the Interior had expressed willingness to recommend the contract but El Paso has asked that its Federal Power Commission license application be held in abeyance, partially because of the difficulties in obtaining their water supply. Serious questions have been raised about approving additional contracts from Navajo Reservoir. They include concern for the legality of New Mexico utilizing more than its entitlement, effect on Indian water rights, and the accuracy of calculations of how much water is available.

WATER RESOURCES PLANNING

The Water Resources Planning Act of 1965 (Public Law 89–80) endeavored to promote comprehensive and coordinated planning for State and Federal water resource development programs in order to encourage the conservation, development, and utilization of the Nation's water and related land resources. The water resources planning program is the best example of a nationwide resource planning effort in the United States. The original national land use planning bills were based on expansion of the Water Resources Planning Act.

The 1965 Act provided for creation of joint Federal-State river basin commissions to produce general plans for guiding water resource

development within the river basins. In the absence of a formal river basin commission, planning functions are to be undertaken by coordinating committees of Federal water resource agencies. Planning is being carried out in the form of broad framework studies for the entire basin (level A) and more in depth plans for sub-regions within the basin (level B). For purposes of the planning program, the country has been divided into twenty regions. Seven river basin commissions have been formed and fourteen framework studies initiated.

The Water Resources Council, which consists of representatives of each of the Federal departments dealing with water resources, was established by the Water Resources Planning Act and given the following charges: (1) review of river basin plans prepared under the Act, (2) administration of a program of grants to the States for water resources planning, (3) establishing principles, standards, and procedures for comprehensive river basin and water resource development planning, and (4) assessment of the Nation's water supplies and needs and the role of Federal agencies in meeting those needs.

The Water Resources Council published its first assessment of the Nation's water resources in 1968 and has begun work on a second. Based on 1975 data, it is scheduled for completion in 1977 or 1978 and will place major emphasis on the water-energy relationship.

The Council has established a task force on energy self-sufficiency but following submission of reports to the Federal Energy Administration's Project Independence Blueprint and to the Council itself, the task force was phased out and responsibility for the water-for-energy investigation placed with the national assessment effort.

A new Energy Developments and Implications Committee has been established to handle responsibilities placed on the Water Resources Council by the Non-nuclear Energy Research and Development Act and it may take on additional roles in water for energy planning: (Sec. 13 of Public Law 93–577, the organic act for the Energy Research and Development Authority, provided that: (1) ERDA could request the Water Resource Council to assess water requirements for non-nuclear energy technologies; (2) for demonstration projects under the act which might significantly affect water resources, ERDA must prepare or have prepared an assessment of that impact; and (3) for financial assistance to commercial energy developments under the act, the Water Resources Council must prepare an assessment of water availability for the development. Section 13 also directed the Council to include water availability for energy in its national water resource assessments).

The most vigorous investigation of water for energy, however, has been by the Department of the Interior. The October 1971 "North Central Power Study" investigated the feasibility of a network of mine-mouth powerplants in the northern Great Plains. The effort of a coordinating committee of electric utility representatives and municipalities, it was nevertheless undertaken at the initiative of the Department of the Interior. The Bureau of Reclamation was the principal participant. This report was followed in April 1972 by a Bureau of Reclamation "Appraisal Report on Montana-Wyoming Aqueducts," which investigated possibilities for supplying water for development of northern Great Plains coal resources. These studies indicated a

strong advocacy for developing the northern Great Plains coal resources and seemed an extension of the industrial water marketing effort. Similar investigations are in progress on supplying water for oil shale development in the Upper Colorado River Basin.

The Department of the Interior has also established a water-for-energy management team which has thus far produced "Report on Water for Energy in the Upper Colorado River Basin," July 1974, and "Report on Water for Energy in the Northern Great Plains Area with Emphasis on the Yellowstone River Basin," January 1975. These reports discuss the water supply and possible water demands for energy development and other uses in these two most critical regions.

WATER LAW

Although water law is largely the domain of the States, there are several areas where Federal policies predominate and thereby could have great effect on the water-for-energy situation. One proposed energy development which has received considerable Congressional attention (because of proposed legislation permiting eminent domain to be used to secure a right-of-way) is a planned coal slurry pipeline from Wyoming to Arkansas. The planned water supply for the pipeline (an industrial water contract from the main stem Missouri has also been applied for) is deep ground water from a large aquifer known as the Madison Formation. The Madison Formation underlies South Dakota and Montana as well as Wyoming, however, and South Dakota is seeking action against the drilling. There is virtually no Federal law to cover interstate ground water situations.

Although water rights are controlled by State law, water rights are reserved for Federal lands and Indian reservations and these rights generally take precedence over water rights under State laws. Indian water rights are known as Winters doctrine rights. Basically the Winters doctrine says that each creation of an Indian reservation had to carry with it enough water to irrigate the irrigable lands of the reservation. The amounts of water could be quite substantial and could have great impact on the availability of water in regions where energy developments are under consideration. The Indians are concerned that if water is given to capital intensive energy operations, even if the water is later proven to rightfully belong to the Indians, they will never get it back. Although the Winters case was decided in 1908, very few Indian water rights have been adjudicated thus far. Based on *Arizona* v. *California* in 1963 there are similar water rights for Federal lands such as national parks and forests which were created by withdrawal from entry. This could also have a substantial effect on the water supply situation in many Western areas and consequently the availability of water for irrigation or energy resource exploitation.

Though water rights are generally the domain of the States in some States it can be relatively difficult to transfer water rights. (This discussion applies to Western States with "appropriation doctrine" water rights. In the East, the States generally use riparian rights and water rights are not separable from property rights.) The National Water Commission (*Water Policies for the Future*, June 1973, pp. 260–270) set forth thirteen recommendations which it felt would facilitate the

transfer of water rights. Since energy developments could generally afford to pay considerably more for water than existing uses—principally irrigation—such action would facilitate the procurement of water for energy.

One of the most volatile water rights issues is the diversion of water from one river basin to another. In passing the Colorado River Basin Project Act—Central Arizona Project Act—Congress placed a moratorium on the study of water importation into the Colorado River Basin—the moratorium will expire in September 1978. Because water is generally very inexpensive it is not usually economically feasible to transfer it great distances. For large scale energy development in the arid West, however, trans-basin diversions might be economically feasible.

Major questions of State versus Federal authority would be raised by any interstate interbasin water diversion proposal; there is virtually no law to cover the situation. The National Water Commission also proposed a scheme for the consideration of interbasin transfers.

CONCLUSION

Development of Western fossil fuels will likely be a major part of the energy-land use interface in coming years and water supply will be a critical factor affecting the magnitude and shape of that development. Much of Federal involvement will be through specific individual projects. There are, however, policies and programs of direct relevance.

The industrial water marketing program of the Bureau of Reclamation is of critical importance to western fossil fuel exploitation; nearly all major proposed western energy developments plan to obtain water from the program. But with a major court decision pending, the mandate for the program is not entirely clear.

Since water, land use, and energy are all such fundamental, all-pervasive resources, planning for any one must inherently involve the other two. Consequently, the water resources planning program is a major vehicle for possible coordination with land use and energy planning efforts, especially in the West.

Several aspects of Federal water law of major importance to energy and land use planning remain to be resolved: these include: interstate ground water law, reserved water rights of Federal and Indian lands, transfer of water rights and trans-basin diversion.

Environmental Controls*

Three specific statutes are treated here (although there are others) as having potential to integrate energy and land use considerations: The Clean Air Act, the Federal Water Pollution Control Act Amendments of 1972, and the National Environmental Policy Act.

THE CLEAN AIR ACT

The Clean Air Act of 1970 (Public Law 91–604) establishes administrative machinery that could have far reaching implications for

*This section of chapter 5 was prepared by W. Wendell Fletcher, Analyst in Environmental Policy, Congressional Research Service.

both energy and land use decisionmaking. The implementation of the act by the Environmental Protection Agency has been guided by two court decisions that could have profound effects on the pattern of future urban development, and on the amount of new energy development permitted in areas that presently have clean air. One of these decisions [13] requires control of the siting of indirect sources of air pollution—major facilities which, while nonpolluting, would attract such a large number of automobiles that a violation of air quality standards could occur. The other decision [14] requires EPA to insure that State air quality programs prevent the significant deterioration of air quality that is already superior to minimum national standards. If fully implemented, the first decision could result in less sprawl type development, increased use of mass transit, and less energy use and air pollution in developing areas. The second decision, if fully implemented, could mean that fewer new air polluting energy facilities will be allowed in rural areas than some energy planners feel are necessary. In addition, implementation of the act is resulting in transportation planning and air quality maintenance planning in urban regions. Both could significantly affect land use and energy consumption patterns in the future.

The court decisions have aroused a great deal of controversy from both environmental and industrial interests. Some environmental groups maintain that EPA is not adequately implementing the court decisions. Some industrial groups and developers, on the other hand, maintain that the Clean Air Act decisions amount to a de facto national no-growth policy.

Implementation of the "no significant deterioration" and the indirect source decisions has not yet really begun, and there are many uncertainties about the eventual outcome. Partially because of the difficulties EPA has encountered in implementing the court decisions, amendments to the Clean Air Act before both the House and Senate are expected to deal with both issues.[15]

The Clean Air Act is likely to be at the forefront in the political struggle now occurring between Federal energy planners and western State governments over possible adverse impacts of Federal energy plans on western States. Several western States have supported the "no significant deterioration" ruling.[16] Federal energy planners, on the other hand, tend to see the ruling as a threat to greater energy independence.

Overall, the Clean Air Act requires EPA to establish national ambient air quality standards for five categories of pollutants.[17] The standards include primary standards, that is, ambient air quality sufficient to safeguard the public health; and secondary standards, that is, ambient air quality sufficient to protect such aspects of the public welfare as property, animals and vegetation. In addition, the act requires EPA to establish new-source standards of performance, which specify the maximum amount of a specific pollutant that may

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[13] *National Resources Defense Council* v. *EPA*, 475 F. 2d 968, D.C. Circuit, 1973.
[14] *Ruckelshaus* v. *Sierra Club*, No. 72–804 (U.S. Supreme Court, 1973).
[15] See S. 3219 and H.R. 10498.
[16] Twenty two states filed amicus curiae briefs in support of affirmance of a "no significant deterioration" ruling. Arizona and Utah filed amicus curiae briefs against affirmances. See *Ruckelshaus* v. *Sierra Club*, op. cit.
[17] Pollutants covered include particulates, sulfur dioxides (SOx), carbon monoxide (CO), nitrogen oxides (NOx), and hydrocarbons (HC).

be emitted by a new stationary source of air pollution, regardless of its location or the air quality of the surrounding region.

The act calls upon States to prepare plans—called State implementation plans—which detail the actions which the States will take to achieve and maintain the national primary and secondary standards. EPA must review each implementation plan. While no State is required to prepare an implementation plan, if a State chooses not to prepare an implementation plan, or if it prepares a plan judged inadequate by EPA, EPA itself is empowered to take the necessary actions to achieve the standards.

Section 110 also requires State implementation plans to include such measures "as may be necessary to insure attainment and maintenance of * * * primary or secondary standards, including, but not limited to, *land use and transportation controls*.[18] (Emphasis added.)

Section 110 also requires State implementation plans to include a "procedure * * * for review (prior to construction or modification) of new sources to which a standard of performance will apply [19] and further specifies that this procedure shall "provide adequate authority to prevent the construction or modification of any new sources to which a standard of performance * * * will apply at any location which the State determines will prevent the attainment or maintenance * * * of a national ambient air quality primary or secondary standard.[20]

Hence, section 110: (1) authorizes the general use of land use controls to achieve the air quality standards, and (2) further specifies that the States must utilize their police powers to regulate the siting of new stationary sources of air pollution in the event that attainment or maintenance of air quality standards can not be otherwise accomplished.

On May 31, 1972, EPA announced initial approvals and disapprovals of State implementation plans.[21] A successful court challenge by the Natural Resources Defense Council (NRDC) and others resulted in a court decision directing EPA to review again all State implementation plans and disapprove those which failed to provide sufficient measures to insure maintenance of national primary ambient air quality standards.[22]

As a consequence of the NRDC decision, EPA, on March 8, 1973, disapproved those portions of all State implementation plans pertaining to maintenance of air quality standards.[23] In response to the court order, EPA has proposed that State implementation plans include preconstruction review procedures for the siting of new "indirect" sources of air pollution, in addition to the specific procedure for reviewing sites for stationary sources of air pollution mandated by Section 110 of the Act. As previously stated, an indirect source of air pollution is a facility which attracts large numbers of automobiles, and which therefore may indirectly contribute to a violation of an air quality standard.

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[18] Public Law 91–604, sec. 110(a)(2)(B).
[19] Public Law 91–604, sec. 110(a)(2)(B).
[20] Public Law 91–604, sec. 110(a)(4).
[21] 37 Federal Register 10842, May 31, 1972. EPA regulations specifying State implementation plan content requirements appeared in 36 Federal Register 15436 (August 14, 1971) and 36 Federal Register 22369 (November 25, 1971).
[22] *Natural Resources Defense Council* v. *EPA*, 475 F. 968, D.C. Circuit, 1973, and *Ruckelshaus* v. *Sierra Club*, No. 72–804 (U.S. Supreme Court 1973).
[23] 38 Federal Register 6279, March 8, 1973.

While final indirect source regulations (40 CFR 52.22) were published in the Federal Register on July 9, 1974,[24] EPA indefinitively suspended implementation of the regulations except as they pertain to highways and airports, in July 1975. EPA has yet to issue specific guidelines to implement the highway and airport regulations, however. Despite the delay in implementation, the July 1974 regulations are still in effect, and several States that had previously developed indirect source control programs have decided to continue their programs.

The July 1974 regulations require the review of the following categories of indirect sources:

1. Highways and roads;
2. Parking facilities;
3. Retail, industrial and commercial facilities;
4. Recreation, amusement, sports and entertainment facilities;
5. Airports;
6. Office and government buildings; and
7. Education facilities.

The size of a project which must be reviewed depends on whether the project would be located in a Standard Metropolitan Statistical Area (a metropolitan area of 50,000 or more). In SMSA's, a proposed indirect source listed above with an associated parking facility for 1,000 or more cars must be reviewed. A modification of a parking facility associated with an indirect source must be reviewed if it would increase parking capacity by 500 or more cars.

For indirect sources outside of SMSA's, the size of an indirect source with parking facilities that would require review is doubled, i.e., 2,000 and 1,000 respectively. Furthermore, within SMSA's, new highway projects with an anticipated average of 20,000 vehicles per day ten years after construction, or a highway modification project with an anticipated daily increase of traffic of 10,000 vehicles must be reviewed. New airports or modifications of existing airports likely to result in 50,000 operations per year must also be reviewed, regardless of location.

In connection with mandated air quality maintenance plans, EPA regulations, published in June 18, 1973, require States to identify areas which, because of existing air quality or because of projected growth rates, have the potential for exceeding national ambient air quality standards in the next ten years.[25] For areas thus identified, called Air Quality Maintenance Areas, an analysis must be made of the impact of anticipated growth and development on the air quality of the area over the next decade, and a control strategy must be prepared to insure attainment and maintenance of standards.

The EPA regulations indicate that each area plan must include "measures to insure that projected growth and development will be compatible with maintenance of the national standards throughout such 10-year period."

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[24] See 38 Federal Register 9539, April 18, 1973; 38 Federal Register 15834, June 18, 1973; 38 Federal Register 29893, October 30, 1973; 39 Federal Register 7276, February 25, 1974; and 39 Federal Register 25292, July 9, 1974, for proposed and final indirect source regulations.

[25] 38 Federal Register 15834, June 18, 1973. Subsequently, EPA issued "Guidelines for Designation of Air Quality Maintenance Areas," which suggested techniques for identifying such areas. EPA is presently in the process of reviewing State designations.

Furthermore, the plan must set forth procedures to determine the impact of new construction on the air quality standards. These measures must include procedures whereby the State or local agency responsible for plan implementation "will prevent such construction or modification if it will result in a violation of the applicable portion of the control strategy or will interfere with the attainment or maintenance of a national standard."

In *Sierra Club* v. *Ruckelshaus*, the courts interpreted the Clean Air Act to require the States and EPA to prevent "significant deterioration" of air quality in regions with an ambient air quality higher than that specified in the national secondary ambient air quality standards.[26] In other words, air quality superior to national standards cannot be permitted to be degraded to the level of the national standards. However, the court did not define what "significant deterioration" is, and since the court decision was based on an interpretation of the act's policy statement and legislative history, little guidance is provided by either the decision or the act itself—as previously noted, legislation now before Congress is expected to give EPA more specific guidelines in implementing the "no significant deterioration" decision. The decision resulted from a suit filed May 24, 1972, by the Sierra Club and others challenging EPA approvals of State implementation plans on the grounds that the plans did not provide adequate protection of air quality superior to the national standards. The District Court of the District of Columbia held that EPA must review all State implementation plans and disapprove "any portion of a State plan which fails to effectively prevent significant deterioration of existing air quality." [27] The initial decision also directed EPA to promulgate regulations in the event a State plan failed to provide adequate measures to prevent significant deterioration.

Since EPA had not previously required States to include nondeterioration provisions in their regulations, the Agency disapproved all State implementation plans on November 9, 1972, insofar as they did not provide measures to prevent significant deterioration". Subsequent to that date, EPA proposed two sets of "no significant deterioration" regulations (on July 16, 1973, and August 27, 1974) and issued final regulations on December 5, 1974.

The December 5 regulations would establish these classes of air quality:

Class I—Those areas where almost no change from current air quality levels will be allowed.

Class II—Areas where moderate change will be allowed, but where stringent air quality constraints will be imposed.

Class III—Areas where substantial growth will be allowed, and where air quality will be allowed to deteriorate up to the national standards.

For the most part, designation of such areas would be left to the state, with some Federal review.

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[26] See *Sierra Club et al.* v. *Ruckelshaus*, Civil Action No. 1031–72, U.S. District Court of the District of Columbia, June 2, 1972. The D.C. District Court decision was subsequently upheld by the U.S. Appeals Court for the District of Columbia, on Nov. 1, 1972, and by the U.S. Supreme Court on June 11, 1973 (*Ruckelshaus* v. *Sierra Club*, No. 72–804). The Supreme Court issued no written opinion, but simply upheld the lower court decision in a four to four tie vote.

[27] 38 Federal Register 18986, July 16, 1973.

It is likely that in class I and class II areas relatively few air polluting energy facilities could be constructed, since the new facilities would be likely to result in significant deterioration of air quality.

In general, there are major opportunities under the Clean Air Act to link air pollution abatement programs to energy conservation through land use planning. Yet, to date, most of the discussion has focused upon the possible adverse impacts of the act upon fossil fuel energy development. Indeed, taken singly, air pollution abatement planning and energy planning may find themselves in opposition at many key junctures. It is clear, for example, that a national policy of "no-significant deterioration" will interfere with and possibly prevent the siting of many new coal burning energy facilities in rural areas. But it is also likely that full implementation of land use controls to achieve air quality objectives will result in an energy conserving development pattern. Without greater integration of air and energy planning, however, it is likely that conflict between the two goals—rather than areas of congreuence will predominate.

THE NATIONAL ENVIRONMENTAL POLICY ACT

The National Environmental Policy Act (NEPA) of 1969 [28] provides a major opportunity for consideration of land use and energy interrelationships in Federal decisionmaking. To date, however, NEPA has not been fully utilized for this purpose.

The act requires that environmental impact statements (EIS) be prepared for major federal actions affecting the quality of the human environment. For the most part, Federal agency EIS preparation is overseen by the Council on Environmental Quality, which issues guidelines to Federal agencies for identifying actions requiring impact statements, and for insuring that other Federal, State, and local agencies and the public have an opportunity to comment on the impact statement. Within the framework of the CEQ guidelines, Federal agencies have responded in a variety of fashions. Some have simply duplicated CEQ's guidelines. Other agencies have issued regulations that reflect specific agency mandates.[29]

NEPA, to date, has been largely a procedural—not a substantive—device. Agencies that meet the letter of the law—that is that publish an environmental impact statement that adequately describes the likely consequences of a project, and alternatives to that project, and that allow adequate opportunity for comment by other Government agencies and the public—have not generally been required to base their decisions on the most environmentally acceptable alternative.

The energy impact of new project proposals has generally not received much attention in environmental impact statement analysis despite the fact that the law indicates that the statements should address "the relationship between local short term uses of man's environment and the maintenance and enhancement of long-term productivity, and any irreversible commitments of resources which would be involved in the proposed action should it be implemented." The CEQ guidelines, specifically, refer to energy and natural resources conservation as important areas of environmental impact.

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[28] 42 U.S.C. § 4321, et seq.

[29] See "The National Environmental Policy Act: How it is working, How it should work," *Environmental Law Reporter,* January 1974, for a discussion.

A recent analysis [30] of the potential of the NEPA process to aid efforts to conserve energy suggests that Federal energy planners have failed to recognize that NEPA, often criticized as an impediment to energy development projects, could actually result in savings of energy, if direct and indirect analysis of the impact of project proposals upon energy resources were made. The article recommends application of recently developed analytical techniques to uncover the "hidden energy demands" of projects as one means for focusing NEPA upon energy problems.

Federal agencies have also generally failed to adequately discuss the land use consequences of project proposals in their impact statements. The record has been particularly bad in terms of analysis of the likely secondary impact of major projects on the land. Major development projects, many if not most of which need federal approval, can affect land use far beyond the actual site of a project.

Even though the record of the EIS process as a means to coordinate land and energy concerns is not what it should be, the fact remains that there is a national environmental policy.[31] The mechanism for enforcement—the EIS—could quite consciously be used by the Federal Government (and by State Governments which have similar laws) as a vector for land and energy policy integration.

THE FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS OF 1972

The Federal Water Pollution Control Act Amendments (FWPCA) [32] amounted to a major restructuring of the Federal water pollution control program. Previously the water quality program had been concerned primarily with a system of water quality standards, analoguous in some respects to the national air quality standards of the Clean Air Act.

The 1972 amendments, however, focus attention on pollution control at the source, by requiring major water polluters to limit the amount of effluent discharged into a waterbody, as well as continuing a water quality standard program. Under the act, a permit system (The National Pollutant Discharge Elimination System [33]) has been established to oversee installation of specified levels of pollution abatement equipment for all point sources—sources that discharge effluent through a conduit or a pipe—of pollution, regardless of the water quality of adjacent water bodies. More stringent effluent limitations may be required if the source empties into a water body that does not meet water quality standards.

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[30] See Michael Gerrard, "Disclosure Hidden Energy Demands: A New Challenge for NEPA," *Environmental Affairs*, fall 1975.

[31] The act declares that it is the continuing responsibility of the Federal Government to (1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations; (2) assure for all Americans safe, healthful, productive, and, esthetically and culturally pleasing surroundings; (3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences; (4) preserve important historic, cultural, and natural aspects of our national heritage, and maintain wherever possible, an environment which supports diversity and variety of individual choice; (5) achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and (6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources. 43 U.S.C. 4331.

[32] Public Law 92–500.

[33] The National Pollutant Discharge Elimination System modifies a permit system established under the Refuse Act of 1899. Prior to the 1972 FWPCA Amendments, the permit program was conducted by the Corps of Engineers. Under the current program, the corps maintains permit requirements for dredge and fill operations, but most of the permit program is now administered by EPA.

Second, the act greatly expanded the amount of Federal aid to States and localities for construction of sewage treatment facilities, and linked the construction grant program to land use planning and regulation on an areawide basis. This focus—contained in sections 201 and 208 of the act—is designed to integrate land and water planning in order to achieve water quality objectives.

The Federal Water Pollution Control Act Amendments of 1972 restructured the previous system for establishing water quality standards. Under the amendments, water quality standards will be revised by the State, and reviewed or revised, if necessary, by EPA on a 3-year basis, in order to meet the act's 1983 interim goal of achieving a water quality adequate for swimming and for the protection and propagation of fish and shellfish in all water bodies of the country.

Finally, the law gives the Federal Government—the Environmental Protection Agency—much more authority to direct, oversee and enforce the pollution control program. Previously, the FWPCA gave the Federal Government enforcement powers only in interstate areas. The 1972 amendments, while still recognizing the contribution of State and local governments, gives the Federal Government the final say in most matters.

Section 208 of FWPCA is designed to integrate the various approaches to water quality management specified in the act through areawide or regional water quality and land use planning processes.

The law calls for Governors to designate an areawide planning agency for areas which, because of "urban industrial concentrations or other factors" have difficult water quality control problems. In other portions of the State, local governments may join together to designate a 208 planning agency. For all other portions of the State, the State itself is to serve as the 208 planning agency.[34]

Once a 208 plan is approved, EPA construction grants for sewage treatment facilities must be consistent with the plan, and NPDES permits must be reviewed for consistency with the plan.

Section 208 establishes general guidelines to be used in areawide planning. The 208 plan must specify various regulatory processes and techniques which will be used to control water pollution. The plan must include a process to regulate the "location, modification and construction of any facilities within the planning area which may result in a discharge of any effluent in the area." [35] Although not defined in the law, "facilities" would appear to refer to any point source of pollution within the area, not just sewage treatment facilities. The provision is similar to the "preconstruction" review procedure required by the Clean Air Act, except that the review need not focus upon impact of the proposed source on a water quality standard.

Second, 208 plans are to include regulatory programs for implementing areawide waste treatment management; 208 plans are to assess waste treatment needs for the region over a 20-year period. Since sewage treatment facilities are a major determinant of land use and growth patterns, control over waste treatment management may have the effect of controlling the pace, intensity and location of new development in an area.

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[34] Section 208(a)(6) states that the State "shall serve as the planning agency for all portions of such State which are not designated . . ." by the Governor or local governments.
[35] Public Law 92–500, sec. 208(b)(2)(c).

The plan must also include control procedures—including land use requirements—to combat nonpoint pollution. Nonpoint pollution—such as sediment from construction sites, urban runoff, and organic wastes from pasture lands—is quantitatively the largest source of pollution nationwide. Although nonpoint pollution is the primary water quality problem in many areas, previous pollution control efforts focused on control of more easily identified point sources.

One specific nonpoint pollution provision in section 208 pertains to mine related water pollution. The act states that a 208 plan must include:

> A process to . . . identify, if appropriate, mine-related sources of pollution including new, current, and abandoned surface and underground mine runoff and set forth procedures and methods (including land use requirements) to control to the extent feasible such sources.

Pollution stemming from coal mining activities—including acid runoff, erosion and sedimentation—is an extremely severe water quality problem in certain areas of the country. Plans to increase coal production—some foresee a doubling of production by 1985—could greatly escalate mine-related pollution damage unless careful control is required.

Finally, the 208 plan is to describe the measures necessary to implement the plan, including the agency or agencies that will be involved, and their legal authority.

Section 201 of the act provides for construction grants to States and localities and requires waste treatment management plans for sewage treatment facilities. The section suggests that, to the extent practicable, waste treatment management should be on an areawide basis and provide control or treatment of all point and nonpoint sources of pollution * * *" Section 201 is similar in philosophy to section 208, but applies to individual construction grants, rather than areawide planning. Section 201 plans must, however, be consistent with section 208 plans.

Sewage treatment infrastructure could be used as a device to reduce urban sprawl, and to therefore encourage energy conservation, since relatively compact development requires less automobile use than sprawl type development, and since high density dwellings require less energy for heating and air conditioning than detached sprawl types of development. A recent study by the Real Estate Research Corp., revealed [36] for example, that energy savings of up to 44 percent could be achieved in high density planned communities when contrasted to low density sprawl communities. Figure I, shows relative energy requirements of three types of development.

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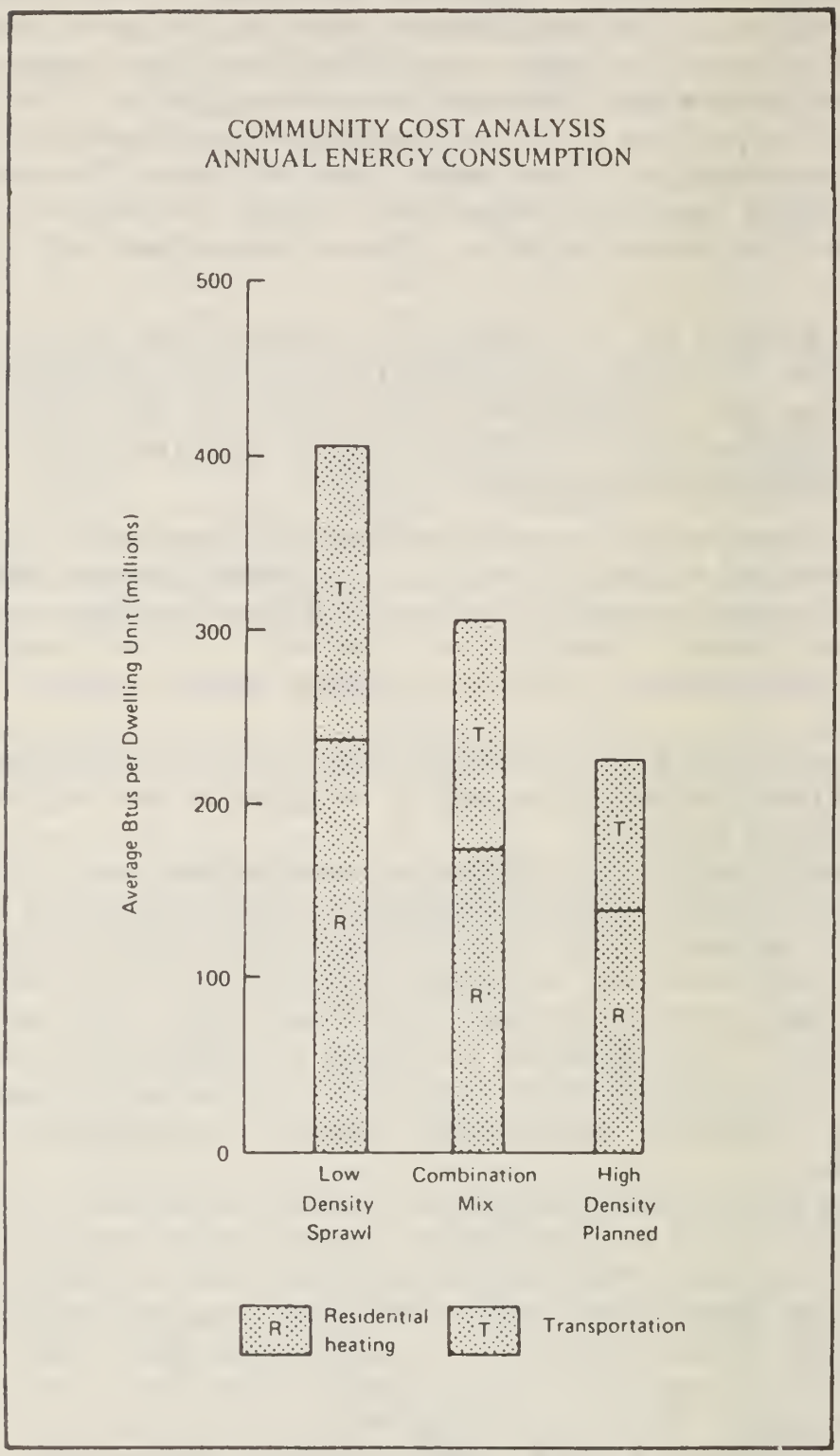
[36] Real Estate Research Corp. *The Costs of Sprawl,* April 1974.

FIGURE 14



Source : The Costs of Sprawl (Real Estate Research Corp.).

Another study [37] has suggested that EPA's sewage construction grant program may be actually encouraging urban sprawl. The report, prepared for the Council on Environmental Quality by Urban Systems Research and Engineering, found that:

[37] Urban System Research and Engineering, Inc. *Interceptor Sewers and Suburban Sprawl: The Impact of Construction Grants on Residential Land Use.* Prepared for the Council on Environmental Quality. July 31, 1974. 191 pp.

—Interceptor sewers are often unnecessarily large, with capacities designed to serve sometimes inflated projections of future population.
—Local community studies showed little evidence of careful assessment of the secondary impacts of interceptor sewer construction.
—Local and Federal financing procedures, the study suggested, may aid future developers more than combat pollution.

The study recommended, among other things, that the Federal Government should only finance that portion of an interceptor project necessary to serve present population, and that the locality itself should finance any excess capacity considered necessary for future population. The study also suggested that the design life of interceptors should be 25 years—and should not attempt to cover the larger populations projected over a 50-year period as is now common.

THERMAL DISCHARGE STANDARDS

Public Law 92–500 contains provisions pertaining to control of thermal pollution. Thermal pollution, caused by heating of water used in industrial cooling processes, can raise water temperatures to a point beyond the tolerance of certain aquatic species. Because powerplants—particularly nuclear powerplants—require vast quantities of cooling water, thermal discharge standards could be a major siting consideration.

EPA has promulgated discharge standards for powerplants, requiring utilization of the best available technology by 1981. The act, however, authorizes exemptions from meeting the thermal discharge standards: under section 316(a), a powerplant can be exempted from the standards if it can be demonstrated that its thermal discharge would not disrupt the natural ecological community of the body of water.

NONDEGRADATION OF HIGH-QUALITY WATER

The FWPCA has a number of provisions dealing with nondegradation of high-quality waters. The act calls for the revision, on a 3-year basis, of water quality standards promulgated under previous water quality laws; and section 302 of the act permits the Administrator to impose more stringent effluent limitations—including alternative control strategies—for point sources in the event that the source would interfere with the maintenance or attainment of water quality sufficient to protect water supply, fish, shellfish and wildlife.

The nondegradation policy of the FWPCA has yet to be implemented. But, like the Clean Air Act, it is likely to require additional land use controls to minimize the impact of adjacent land use on water quality. It could, therefore, affect future siting of energy facilities in areas with relatively pristine water.

CHAPTER VI.—LAND AND ENERGY FOR THE FUTURE*

The previous chapter, on the vectors for policy integration, suggests a conclusion for this study that is as simple as it is obvious: because land use and energy considerations interconnect so thoroughly, land and energy policy really ought to be integrated. Further, because there is no comprehensive national-level mechanism to achieve this integration at present, policymakers can press the mechanisms that do exist into service. By adjusting existing policies—especially transportation, water resources, and environmental controls where Federal statutory authority has already been established—much can be done to bring about coherence and to avoid destructive competition between land use and energy goals.

Some States and some Federal agencies, as pointed out elsewhere in this study, are already making a start on using whatever mechanisms are at hand to bring about coherence. But the effort is tentative, and much more specific policy guidance will be needed fully to capture the potentials, through planning, that comprehensive policy integration might be able to produce.

A key problem for both energy planners and land use planners at present is the virtual impossibility of determining what the precise energy needs and sources for the future will be; yet the characteristics of energy demand will dictate the nature, the extent, and the location of new energy and land development. The Arab oil embargo in 1972 produced not only an unwonted shortage of fuel, but a new appreciation that the traditional assumptions so confidently used in the past to forecast energy demand were becoming suspect. For the most part, demand forecasts prepared in the 1950 to 1972 period were based on projections of past uses, sources, and growth of energy demand. Thus, the projections revealed a high-energy future. In contrast, post-embargo studies showed a significant lowering of demand estimates. While the pre-embargo forecasts produced an estimated range of energy growth from 2.5 to 4.8 percent annually, after the embargo estimates dropped to 2.0 to 3.1 percent growth.[1]

A number of factors can explain this shift in demand estimates. These include the relative certainty that energy prices will continue to escalate; the reluctance or inability of the energy industry to come up with the capital necessary to insure past growth rates; and, importantly for the purposes of this discussion, the increasing likelihood that energy conservation policies will eventually influence growth rates. It is important because energy conservation may in the end have a controlling effect on land use policy. Indeed, Denis Hayes' recent and widely reported assessment of energy need may be as sig-

*This chapter was prepared by Charles E. Little, Specialist in Environment and Natural Resources Policy, Congressional Research Service, with assistance from W. Wendell Fletcher, Analyst.

[1] Herman Franssen, *Towards Project Independence: Energy in the Coming Decade.* Committee Print prepared for the Joint Committee on Atomic Energy, 94th Congress, 1st Session. Washington, D.C. U.S. Govt. Print. Off., December 1975. pp. 1–10.

nificant to land conservationists as to energy conservationists. Says Hayes, "More than one-half the current U.S. energy budget is waste. For the next quarter century the United States could meet all its new energy needs simply by improving the efficiency of existing uses." [2]

This finding, if expressed in energy policy, could have two meanings for the proponents of land use policy and planning. First, it could eliminate the present land-ethic-versus-energy-independence conflict. Two hundred nuclear plants would not be needed in the next 10 years, nor would 250 new coal mines, 150 coal-fired powerplants, 30 new refineries, 20 new synthetic fuel plants, or "the drilling of many thousands of new oil wells"—offshore and on—that President Ford last year proposed.[3]

The second effect of energy conservation on land use policy may be, in the longer range, even more impressive than the first. A reduction of energy use—or as Hayes would have it, the foregoing of waste—has been said to require what many call a basic "lifestyle" change. This does not mean, however, that everyone will have to go back to the land to avoid freezing to death in the dark. Hayes' view is that the changes need be no more than "cosmetic". Indeed, European lifestyles can hardly be called primitive; Sweden, West Germany, and Switzerland—which have about the same per capita GNP as the United States, consume only 60 percent as much energy per person. This is not to say, however, that changes in U.S. consumption would not require policy modifications in transportation, in settlement patterns, and in corporate practice. These modifications could have the effect of curbing urban sprawl, avoiding needless ecological disruption, and reducing uglification—all of which are land-use goals.

But what about the economy? Because there has been an historic correlation between energy consumption and the gross national product, many economists believe that it is impossible to reduce the energy growth rate significantly without adversely affecting the economy.

Hayes's view on this, based in part on European experience, is that the "standard of living" at least will not have to be radically different. This position is supported by the Ford Foundation's Energy Policy Project which found that an average annual growth rate in energy consumption of a low 1.9 percent—less than half that of the early 1970's—would not produce any change in the standard of living.[4] The real economic culprit, according to the Ford study, is not likely to be an absolute decline in energy use but "surprise", unexpected changes in energy availability or cost which would upset economic balances before they had a chance to adjust a new conditions. In fact, the Ford report suggested that it appeared feasible to achieve zero energy growth after 1985 and to retain virtually the same rate of economic growth as would obtain under higher energy growth scenarios.

Significantly, many of the reasons advanced by the Ford study for limitating energy growth have to do directly or indirectly with land use. Among them: adverse land and growth impacts of furious exploitation of remaining fuel resources; pollution reduction; avoiding

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[2] Denis Hayes. *Energy: The Case for Conservation.* Washington, D.C.: Worldwatch Institute, January 1976, p. 7 ff. Hayes was director of the Illinois State Energy Office and has been a visiting scholar at the Woodrow Wilson Center of the Smithsonian.

[3] Gerald R. Ford. "State of the Union Message." Jan. 15, 1975. p. 11.

[4] Ford Foundation. *A Time to Choose.* Cambridge, Mass.: Balinger, 1974. pp. 86–89.

climatic alterations; avoiding catastrophic accidents in energy supply systems; and increasing concern among citizens that centralized energy systems are not responsive to the needs of individuals and of society.

If energy needs can be satisfied through conservation, and if conservation does not need to affect economic stability as Denis Hayes and the Ford Foundation study suggest, and, further, if energy conservation produces the kind of land use effects generally thought to be desireable, then energy conservation should be a primary determinant in shaping an integrated land-and-energy policy for the future.

For its part, comprehensive land use policy and planning could play a major role in an energy conservation program. For example, the sprawl pattern of development—in part created by and wholly sustained by dependence on the private automobile—requires a great deal more energy to run than more compact community designs. The land-use goal and the energy conservation goal converge in the finding that properly designed communities and developments would require less energy, would requires less land, would produce less environmental impact, and could cost less money. The recent report, *The Costs of Sprawl*, often cited in this study, reveals that energy savings of up to 44 percent obtained in high-density, planned communities when compared to unplanned growth because of decreased auto used and less need for residential energy.[5]

Another area where substantial improvements in the use of energy could be made is building heating and cooling, and water heating. All told, one quarter of the Nation's direct fuel consumption goes for these purposes. Upgrading of building code standards to require installation of better insulation and other measures could, according to Denis Hayes, reduce the U.S. energy budget by 16 percent over the next quarter century. It is interesting to note that California's Energy Resource Conservation and Development Act deals with this opportunity through a traditional land-use control mechanism. The statute calls on the state energy commission to develop building-code energy conserving regulations for implementation by local governments through subdivision regulation.[6]

This analysis may rest on some fragile assumptions about the economics of energy conservation. But the assumptions are more than mere guesses. Because of this, it may make good sense to shape future policy debate on land use in terms of energy conservation as the sine qua non of such traditional criteria as protecting critical areas, reducing natural hazards, curbing sprawl, conserving prime agricultural land, carefully siting key facilities, and preserving landscape quality. These are the effects of good land use planning, but they are effects of energy conservation as well. It seems unlikely that they can be achieved in an atmosphere of a panicky "rush of energy."

Thus can energy policy and land use policy be synthesized: not simply to produce a kind of Mexican standoff between them, but more importantly—through energy conservation by and with land use planning—to produce a desirable convergence of goals for the whole of society and for the nature of its growth, quantitatively and qualitatively. Writes Lynton K. Caldwell, "That such a comprehensive policy

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[5] Real Estate Research Corporation. *The Costs of Sprawl*. Washington, D.C.: U.S. Govt. Print. Off., 1974. p. 147, (Table 69).

[6] Cal. Pub. Res. Code §§ 25000 et seq. (West Supp. 1975).

synthesis based upon a philosophy of controlled organic growth may be beyond the intellectual and institutional capabilities of contemporary American society is no argument against its validity. It may be the only approach to policy in these matters that will 'work' in the long run." [7]

Caldwell fears for the capability of society to rise to the occasion. Yet, based on some of the evidence presented in this study, his fears may not be altogether justified. While it is true, as Stewart Udall has pointed out, that "the future is not what it used to be," [8] an emerging energy-conservation *cum* land-use-planning future may in some respects be even better, or at least not too bad. Many are beginning to see important benefits arising from land and energy scarcity—a return to a sense of place and to community, a less demanding and simpler lifestyle.

As William Ophuls has put it, "A very good life—in fact an affluent life by historic standards—can be lived without the profligate use of resources that characterize our civilization." [9] Whether one's perspective is from the standpoint of energy policy or land use policy, what is clearly needed is a coherent framework to make it all come together in a way that will produce the good life for everyone.

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[7] Lynton K. Caldwell. "The Energy Crisis and Environmental Law: Paradox of Conflict and Reinforcement." *The New York Law Forum,* Spring 1975, p. 759.

[8] Stewart L. Udall, *The Energy Balloon,* New York: McGraw-Hill, 1974, p. 136. The phrase is quoted from Paul Valery. Elsewhere in Udall's book is this view: "It is a fortuitous coincidence of history that some of the most important reforms dictated by the energy crisis, such as the decreased reliance of the automobile and the building of better public transportation networks, come at a time when the Nation appears to be ready to adopt wise land-use policies and begin reshaping our cities into better human environment." (p. 188. Udall's energy policy prescription: "It will be a marching order for America, and it can be stated in 26 words: It is the policy of the United States to use energy resources with the highest degree of efficiency, and to conserve energy wherever and whenever possible." (p. 274).

[9] William Ophuls. "The Scarce Society." *Harper's Magazine,* April 1975.

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